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Chung et al.

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(54) **ANTI-C5 ANTIBODIES AND METHODS OF
TREATING COMPLEMENT-RELATED
DISEASES**

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filed on Aug. 5, 2013.

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A61K 39/395 (2006.01)

C07K 16/18 (2006.01)

(52) **U.S. Cl.**

CPC **C07K 16/18** (2013.01); **C07K 2317/24**
(2013.01); **C07K 2317/33** (2013.01); **C07K**
2317/34 (2013.01); **C07K 2317/52** (2013.01);
C07K 2317/622 (2013.01); **C07K 2317/76**
(2013.01); **C07K 2317/92** (2013.01); **C07K**
2319/30 (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

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(57) **ABSTRACT**

The present invention relates to an antibody against C5, and
a method for preventing and treating complement-related
diseases using the antibody, wherein the antibody against C5
is effectively usable in preventing and treating complement-
related diseases by inhibiting complement activation.

13 Claims, 15 Drawing Sheets

Specification includes a Sequence Listing.

FIG. 1

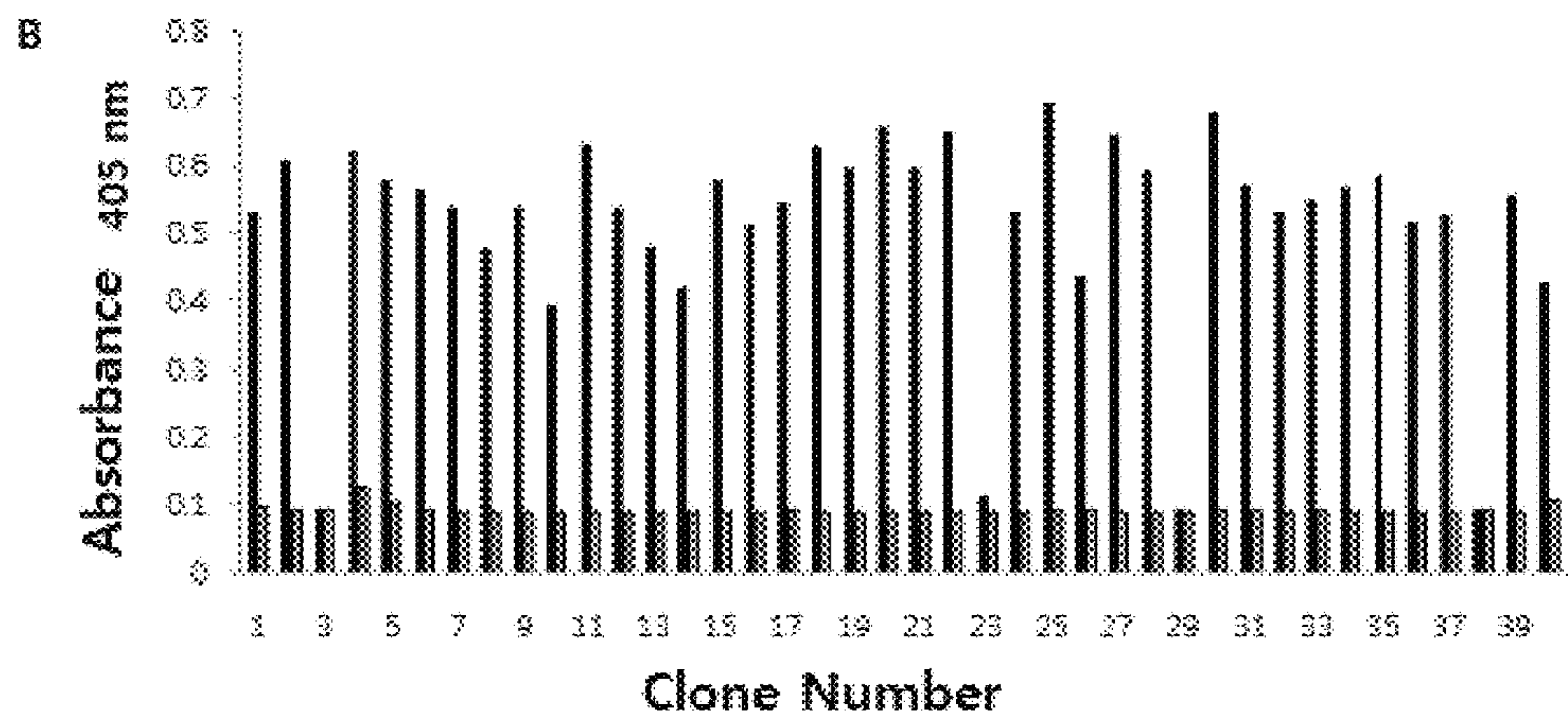
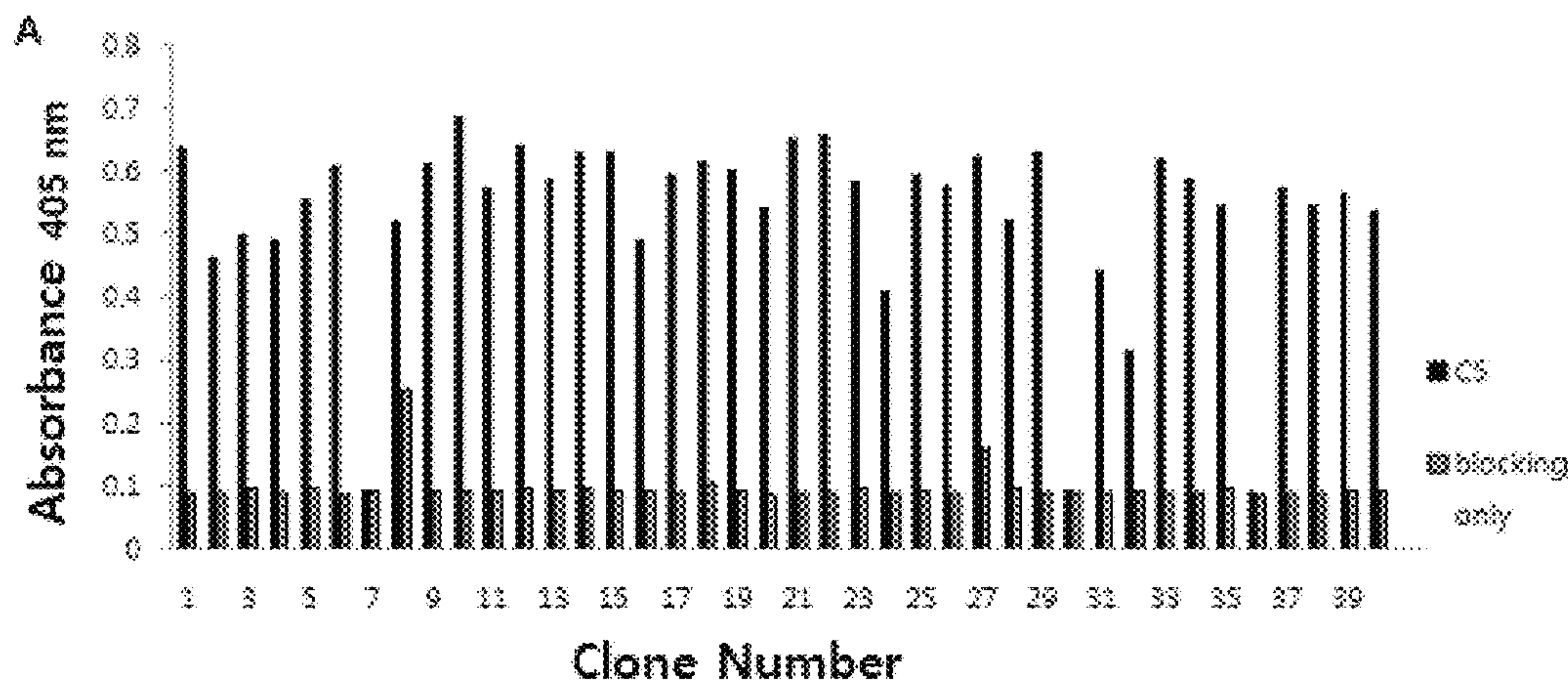


FIG. 2

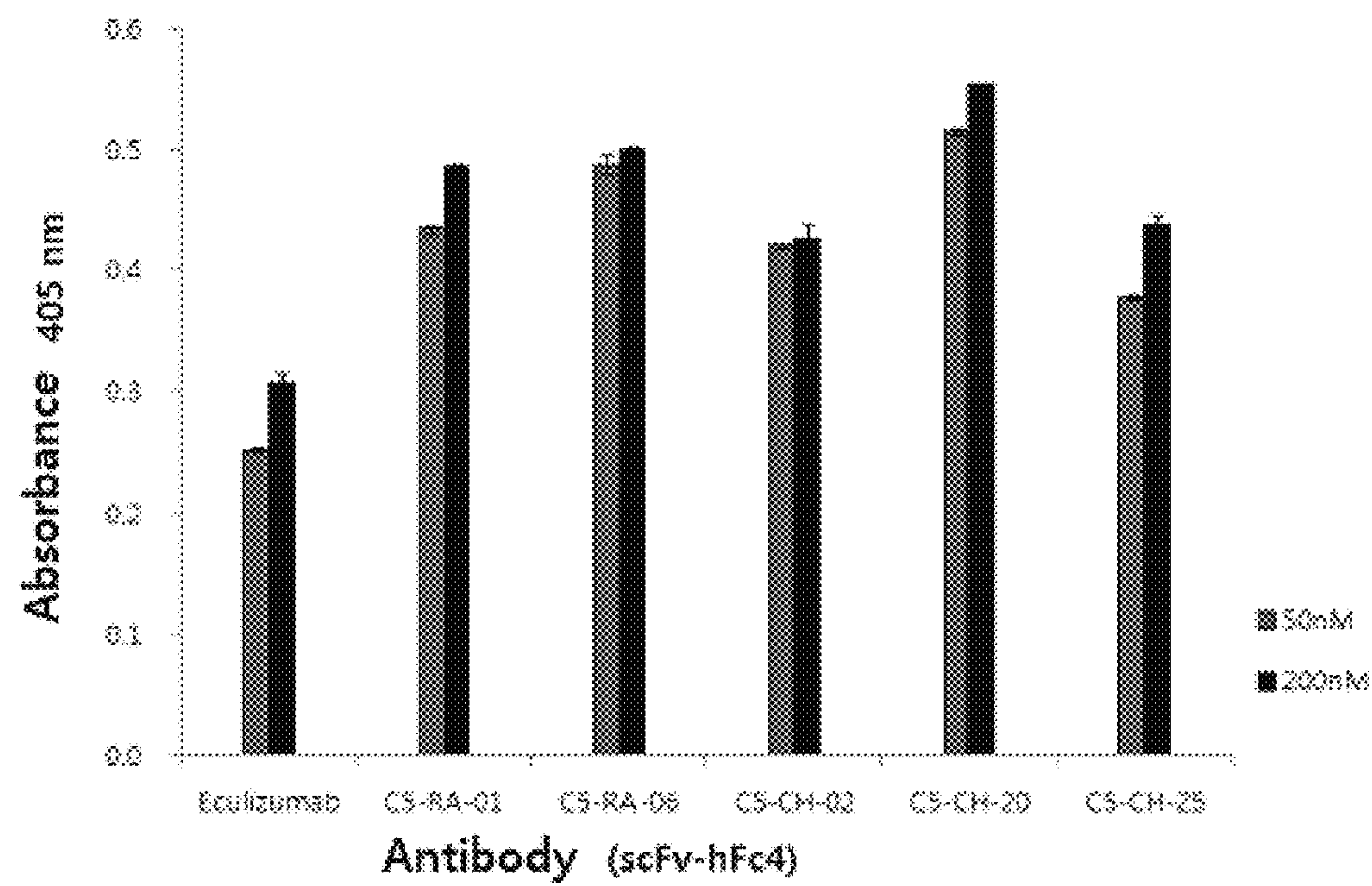


FIG. 3

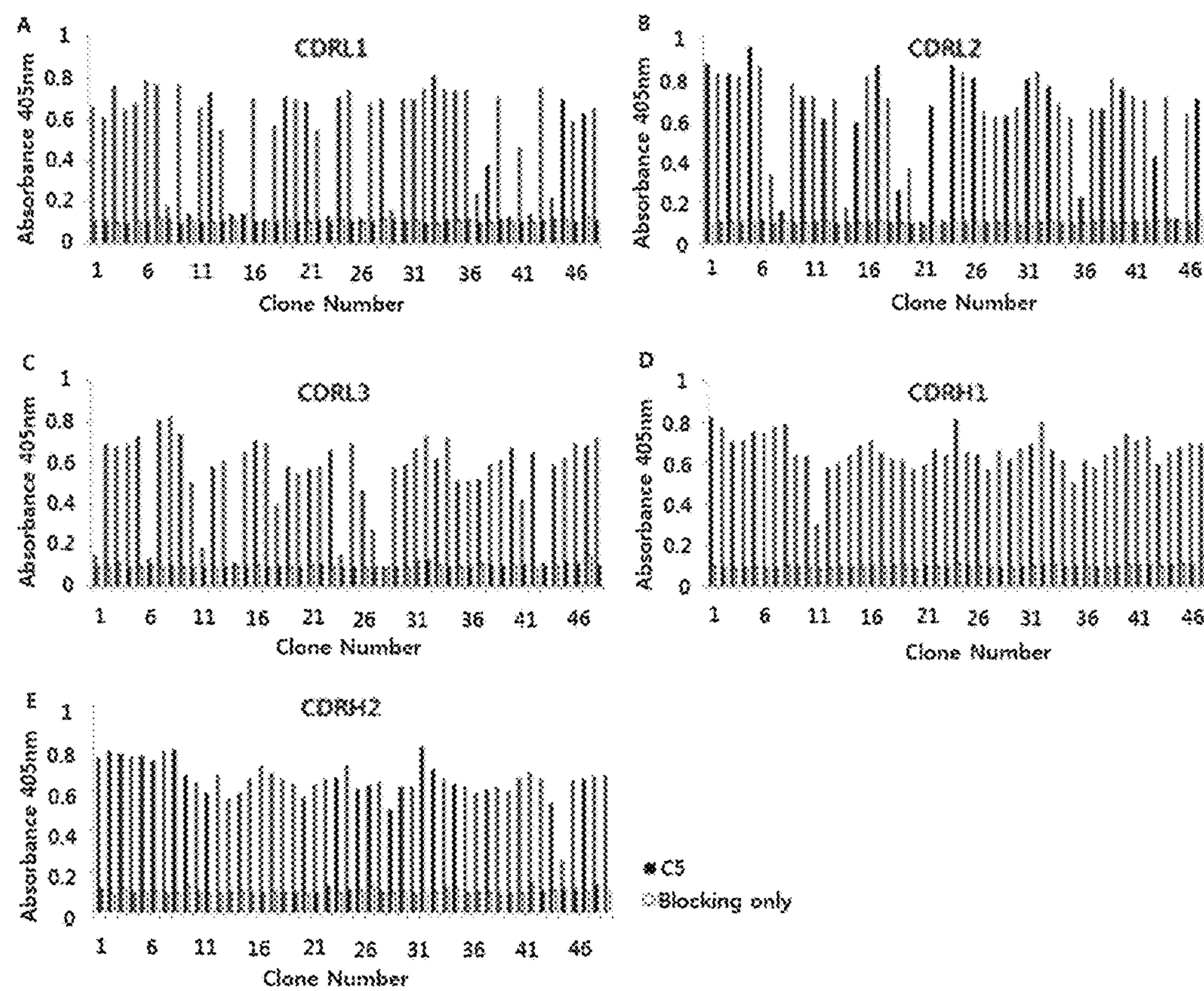


FIG. 4

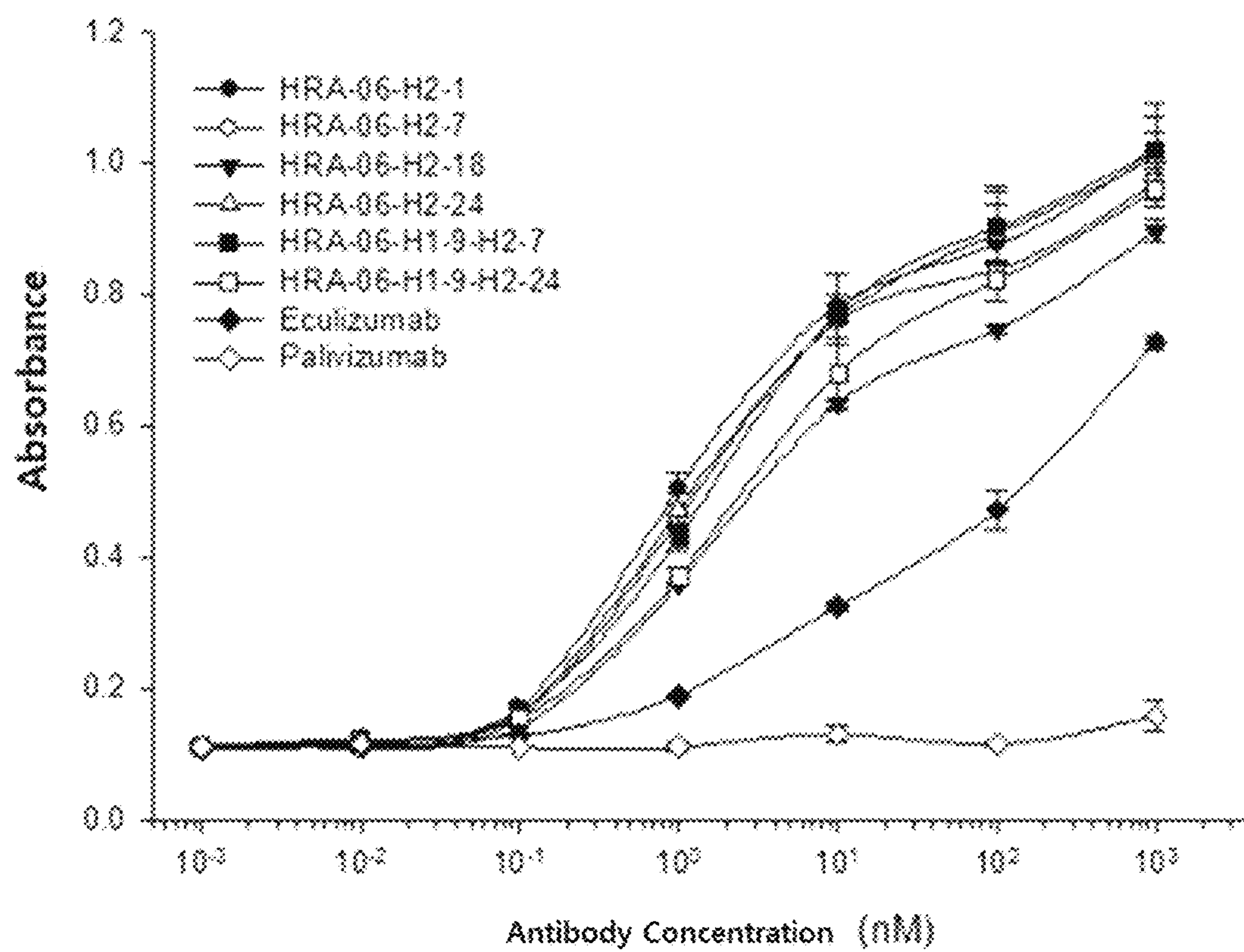


FIG. 5

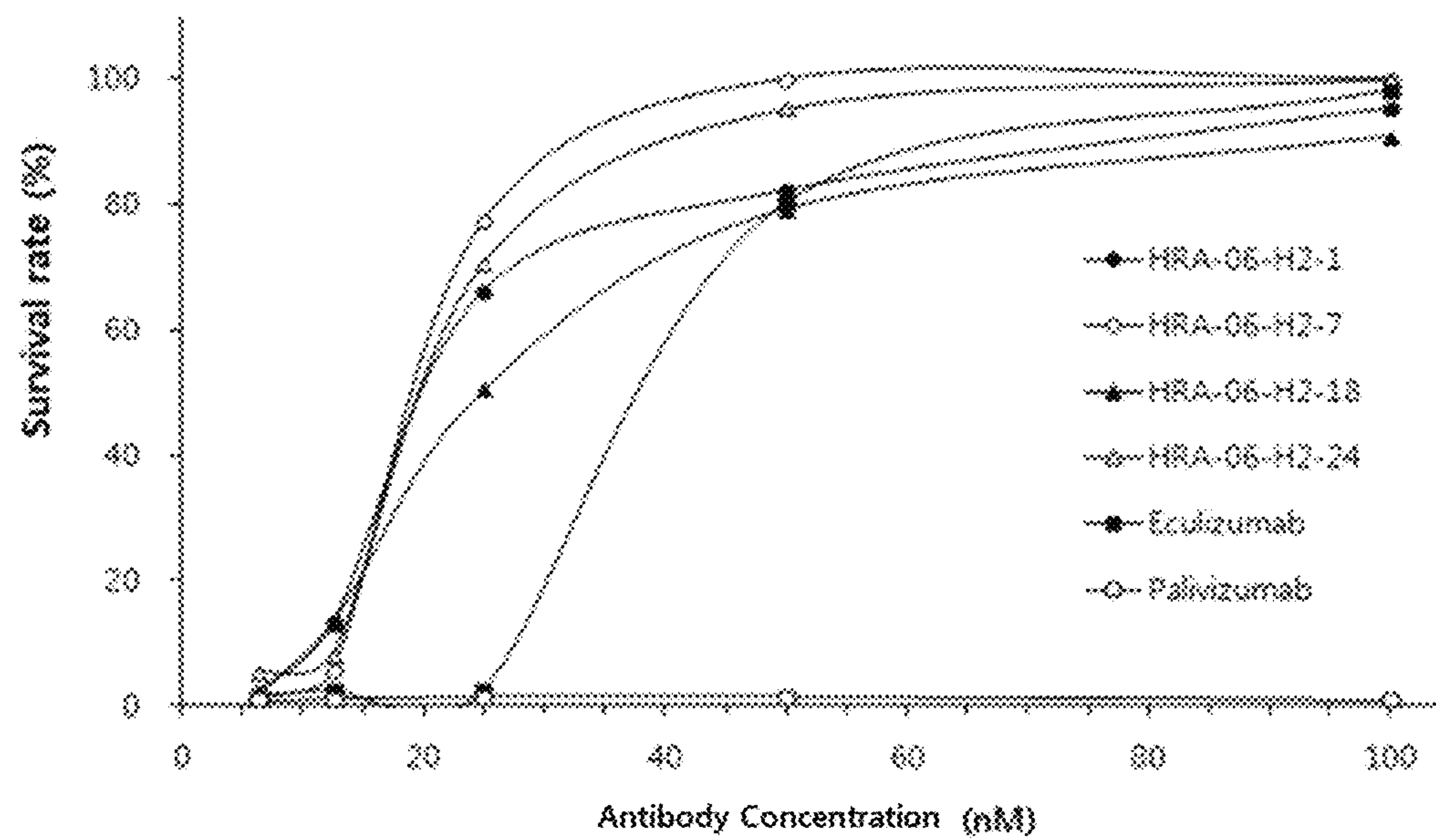


FIG. 6

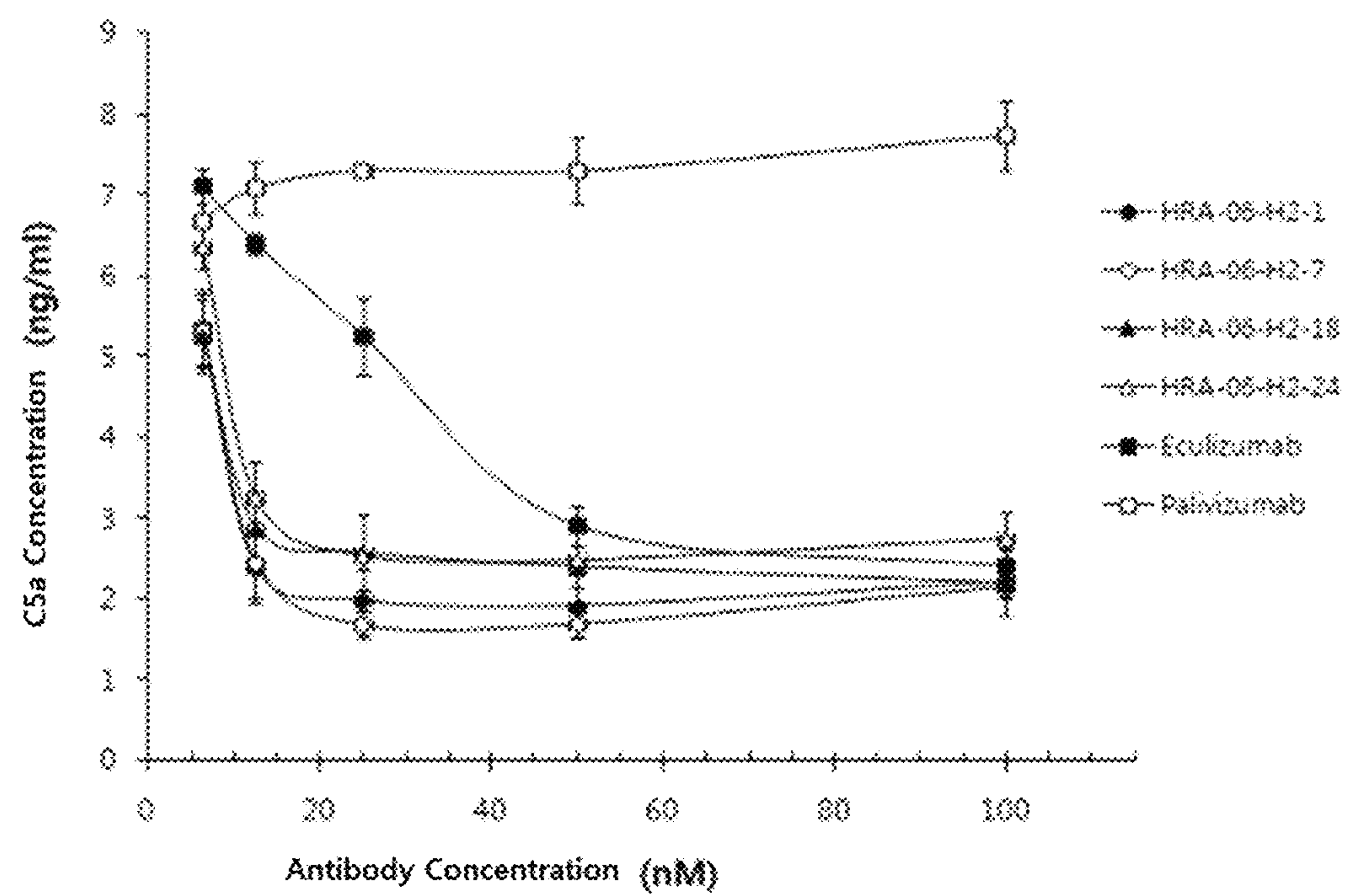


FIG. 7

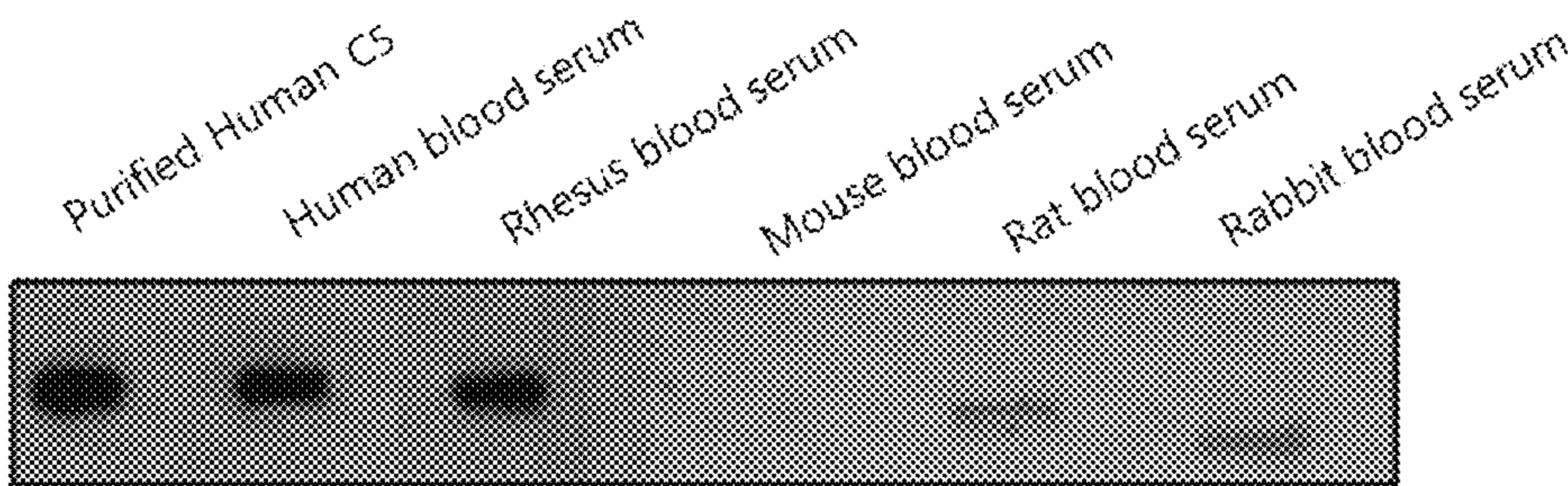
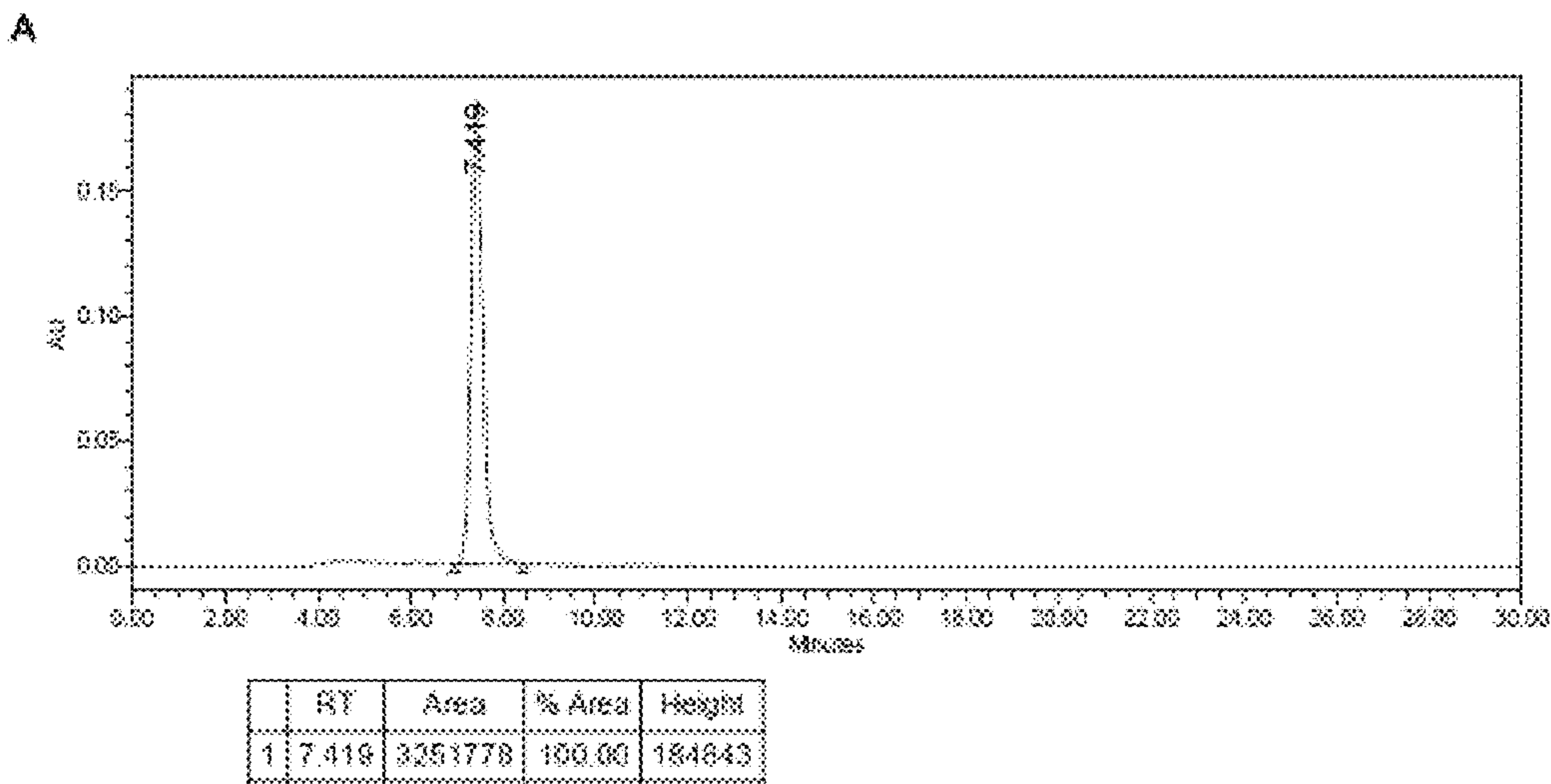
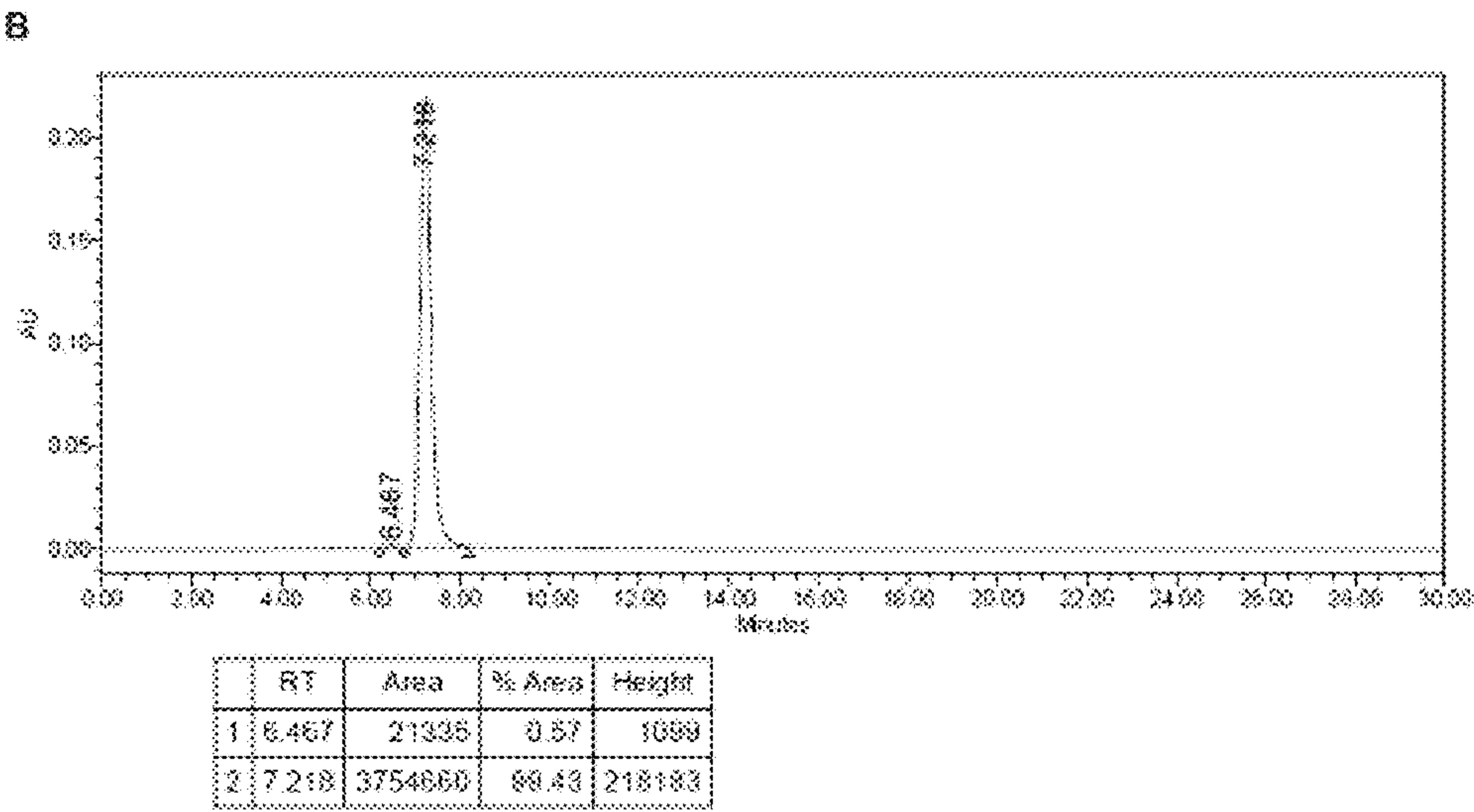


FIG. 8a



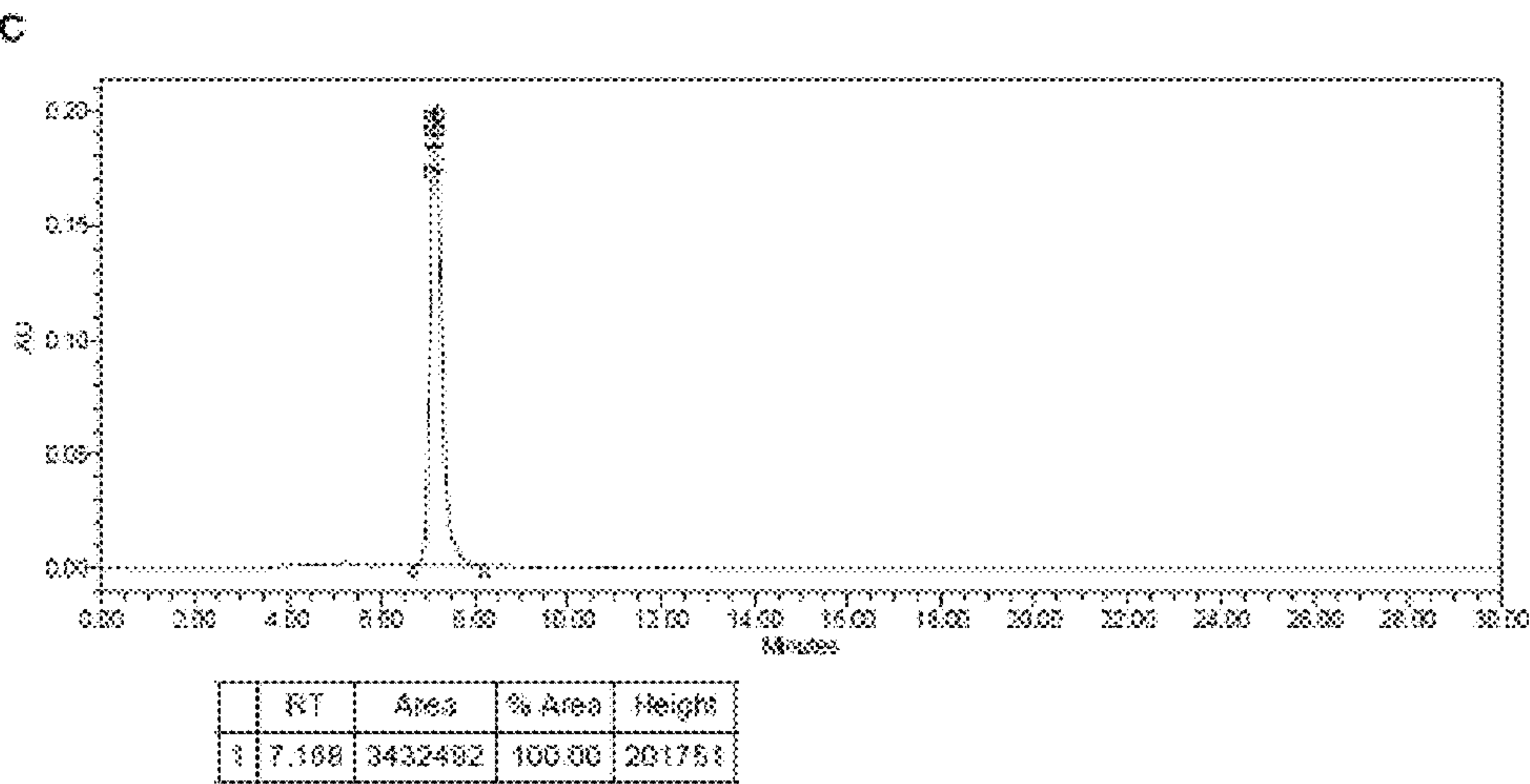
HRA-06-H2-1

FIG. 8b



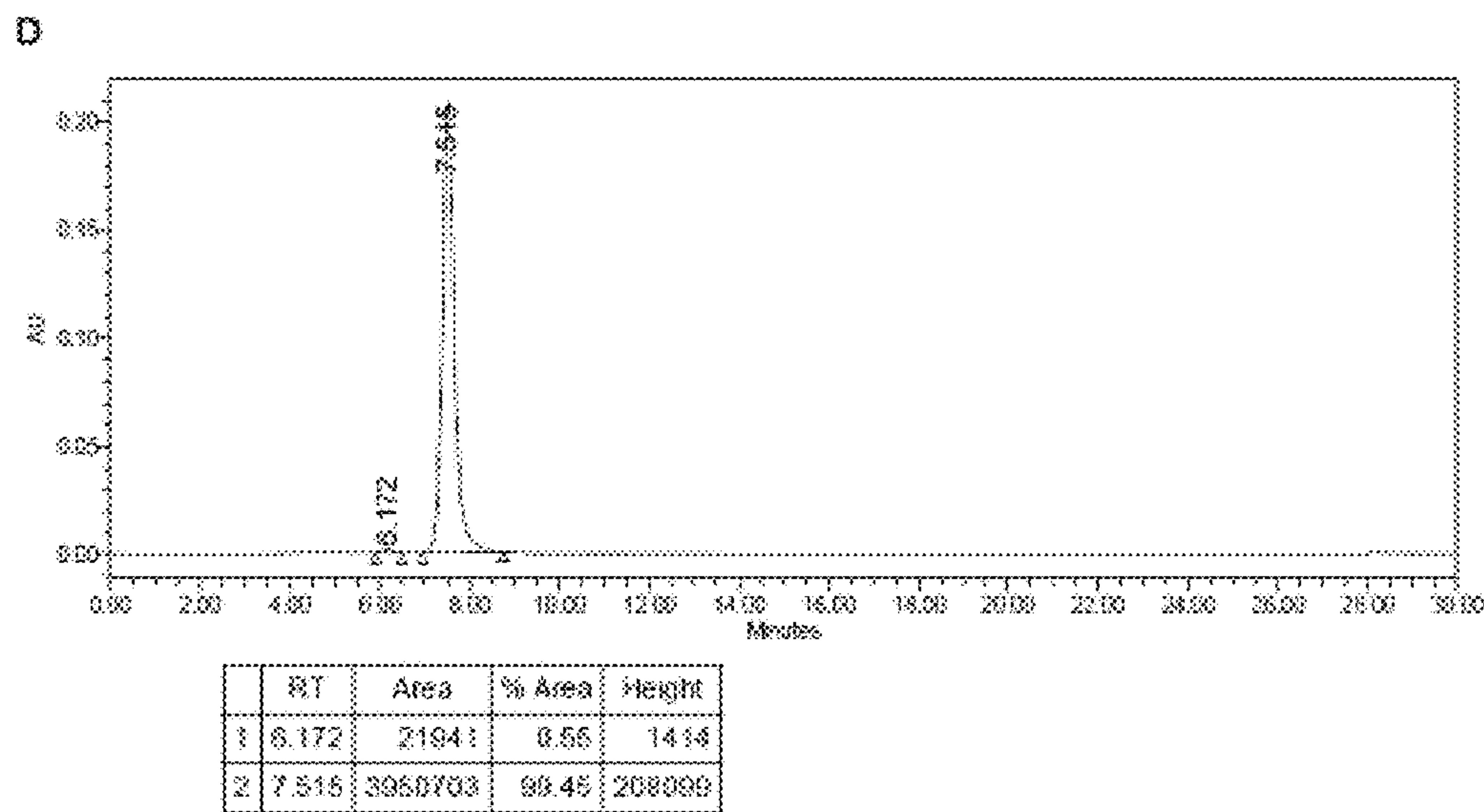
HRA-06-H2-7

FIG. 8c



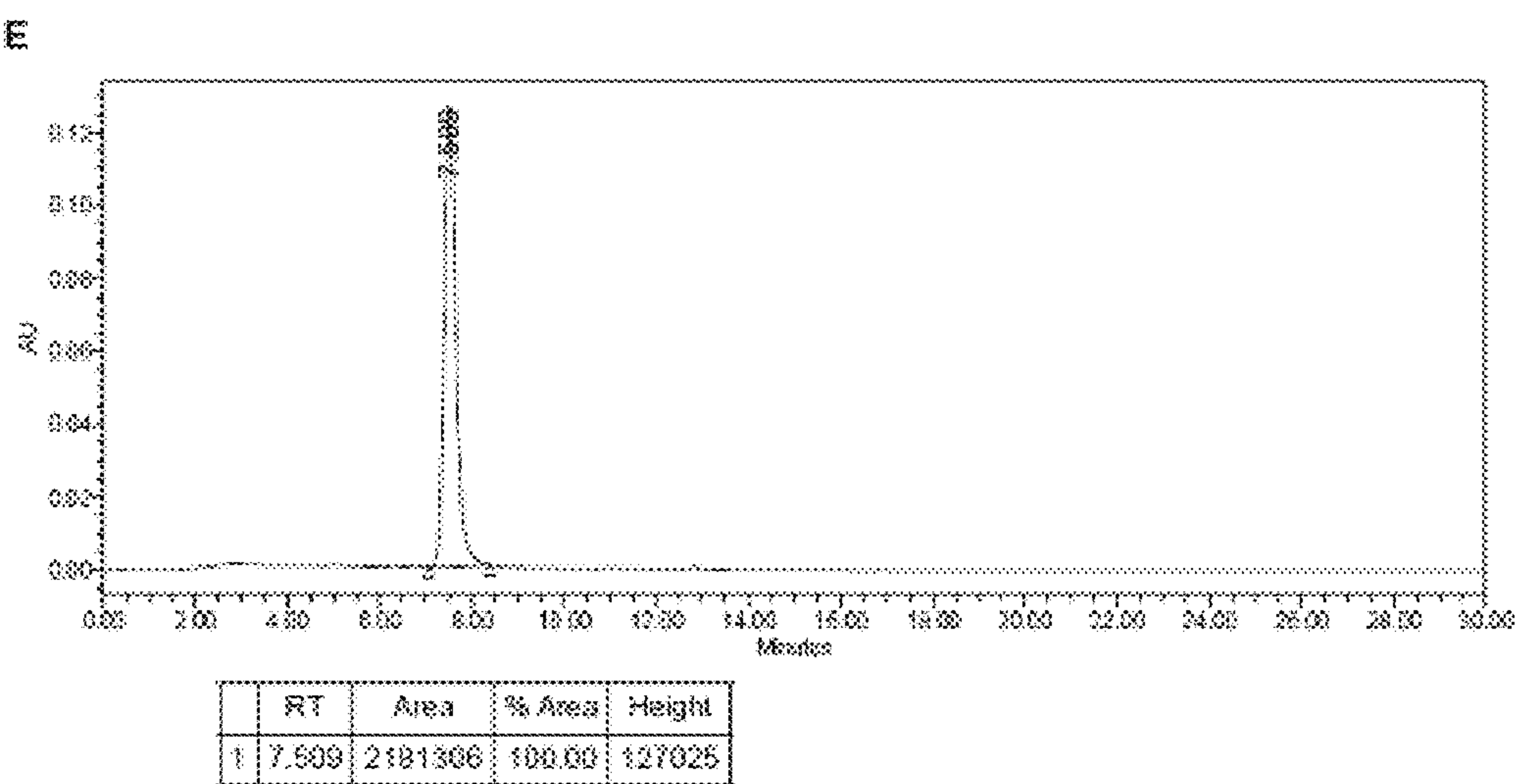
HRA-06-H2-18

FIG. 8d



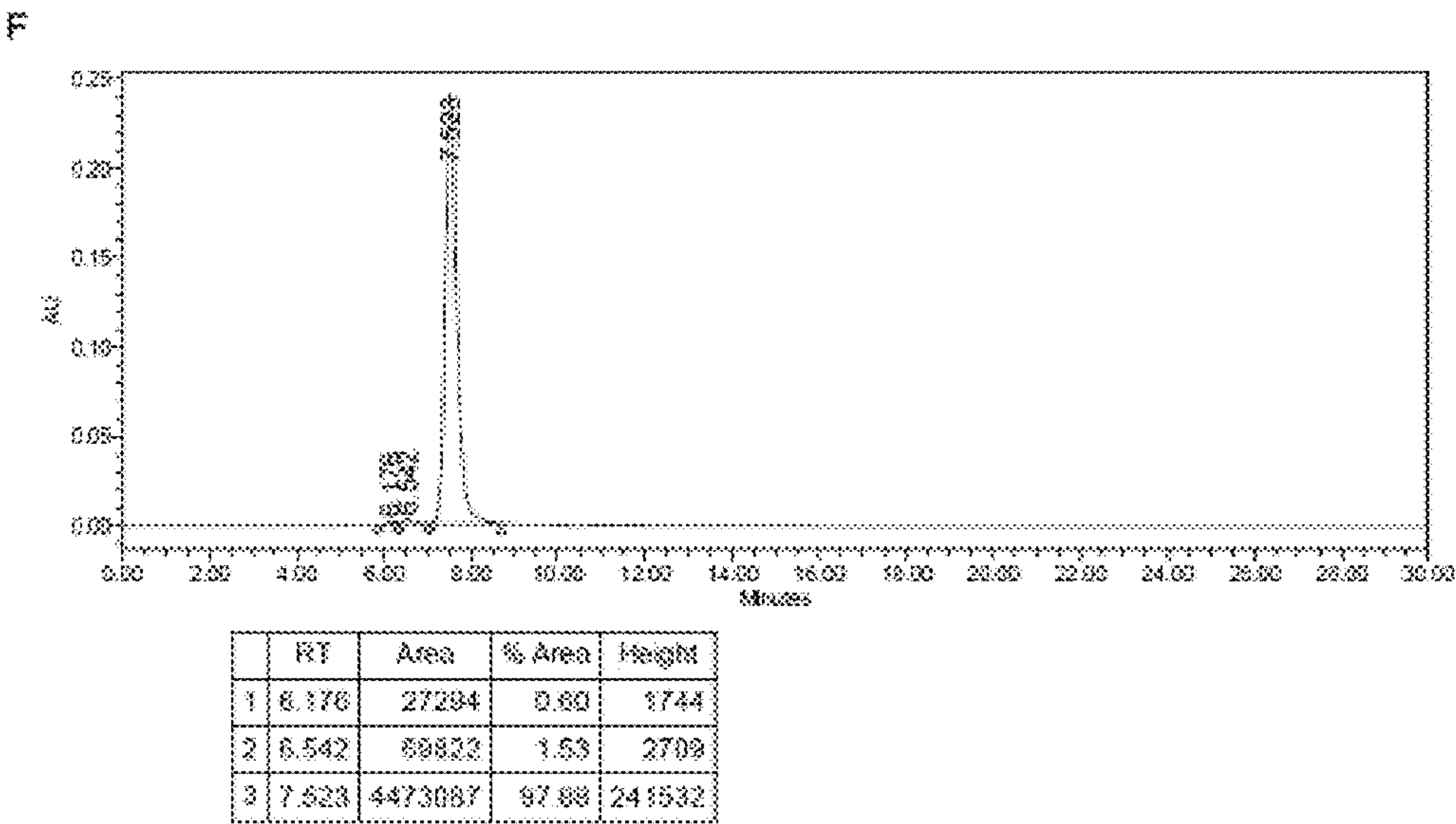
HRA-06-H2-24

FIG. 8e



HRA-06-H1-9-H2-7

FIG. 8f



HRA-06-H1-9-H2-24

FIG. 9

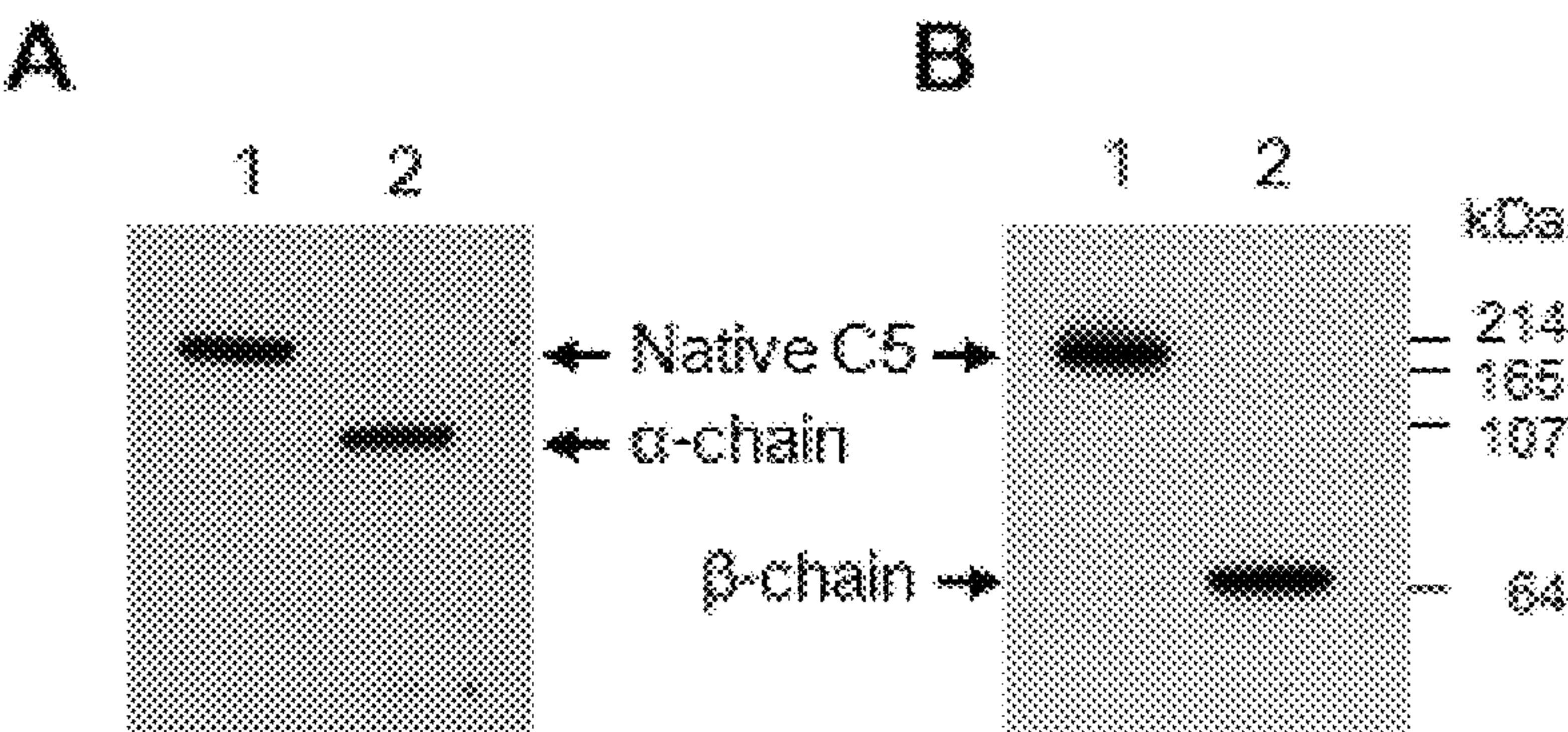


FIG. 10

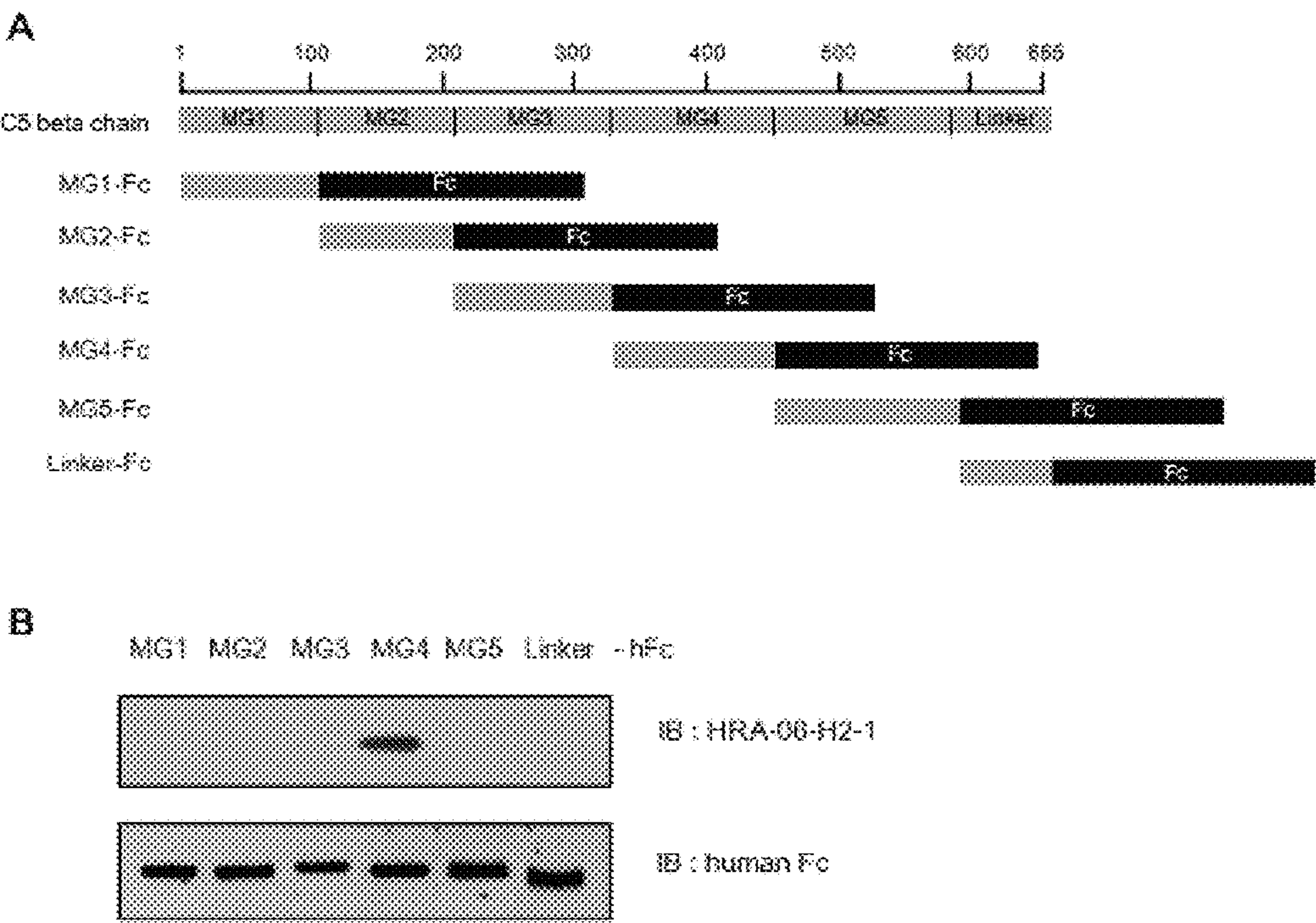


FIG. 11

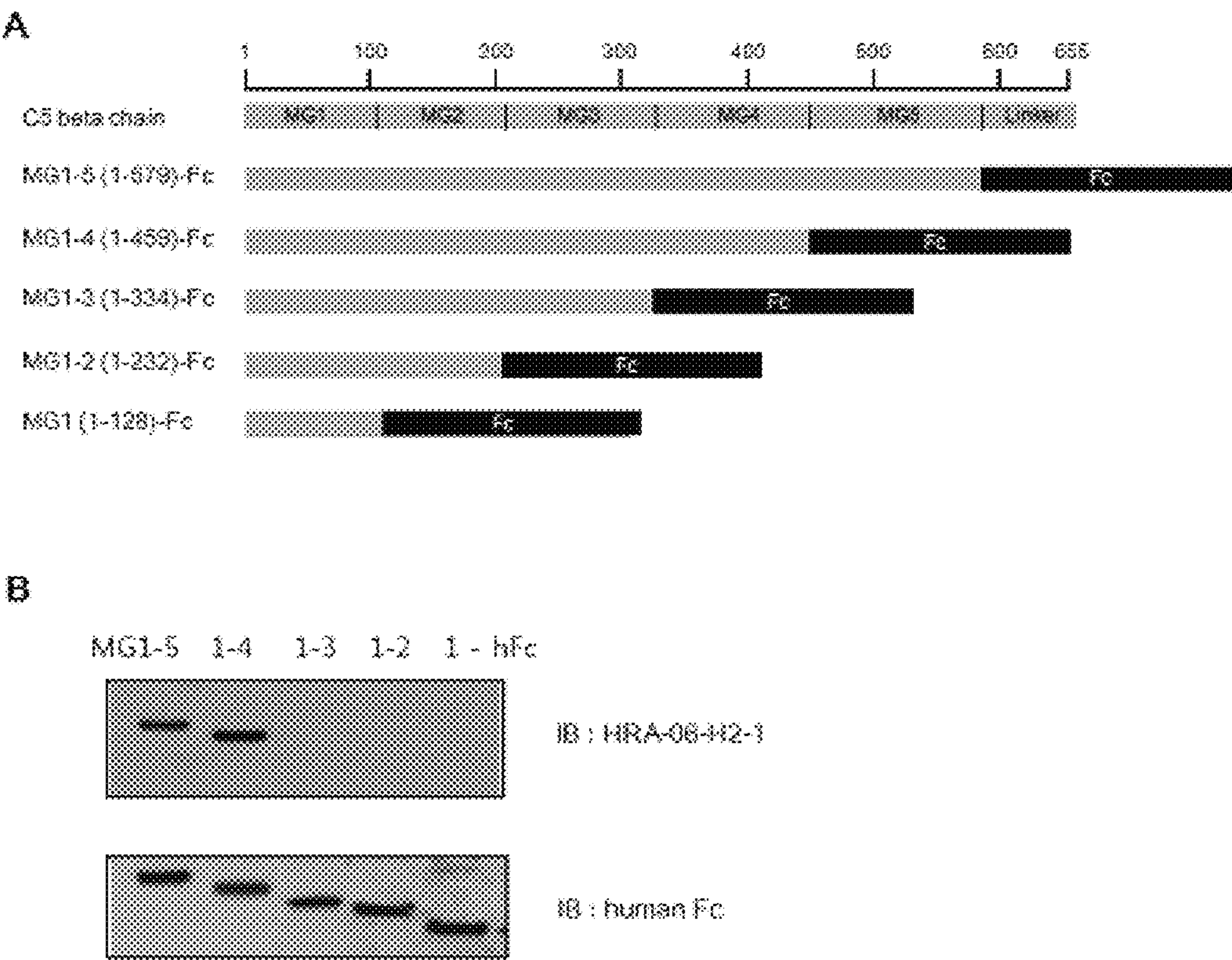


FIG. 12

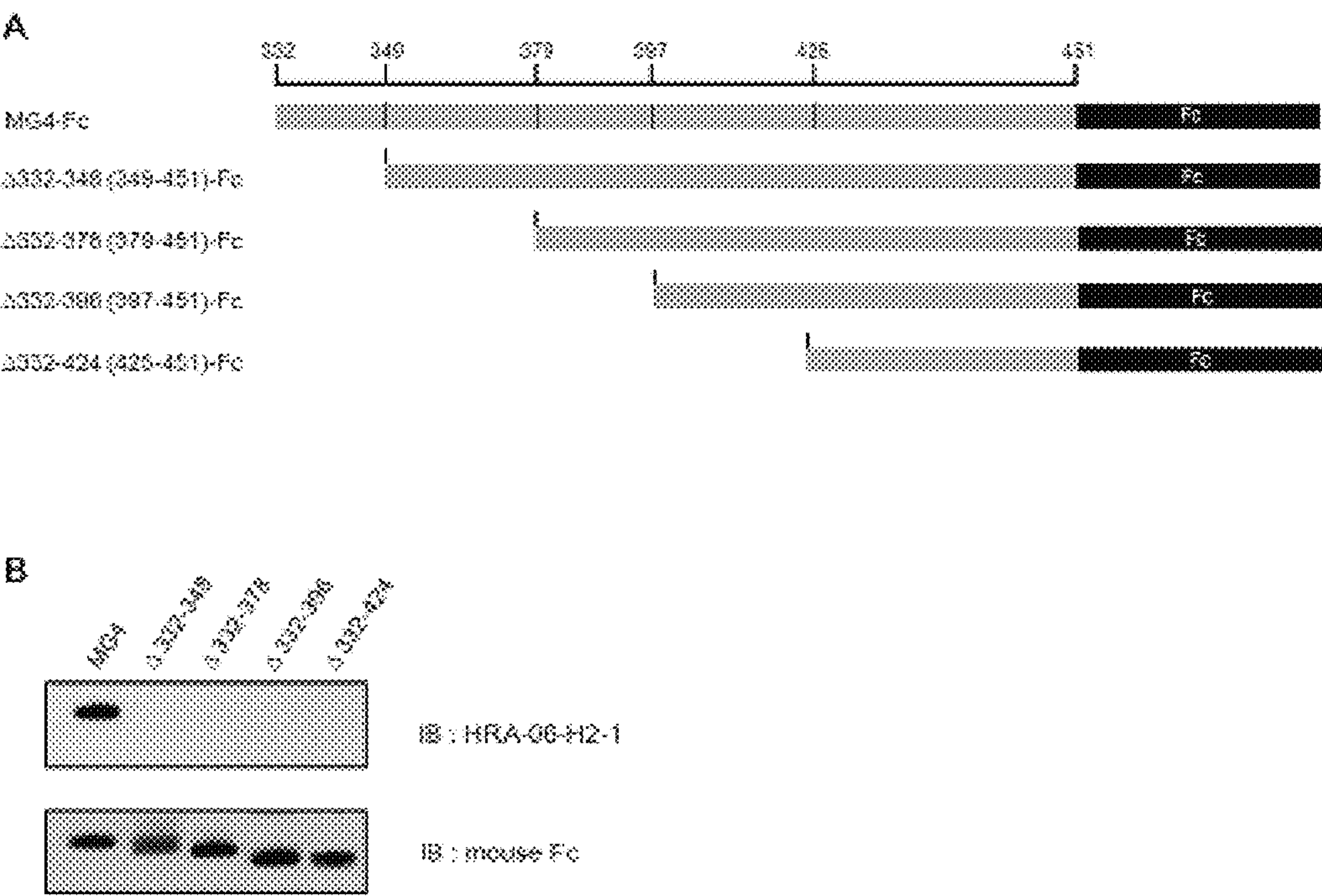


FIG. 13

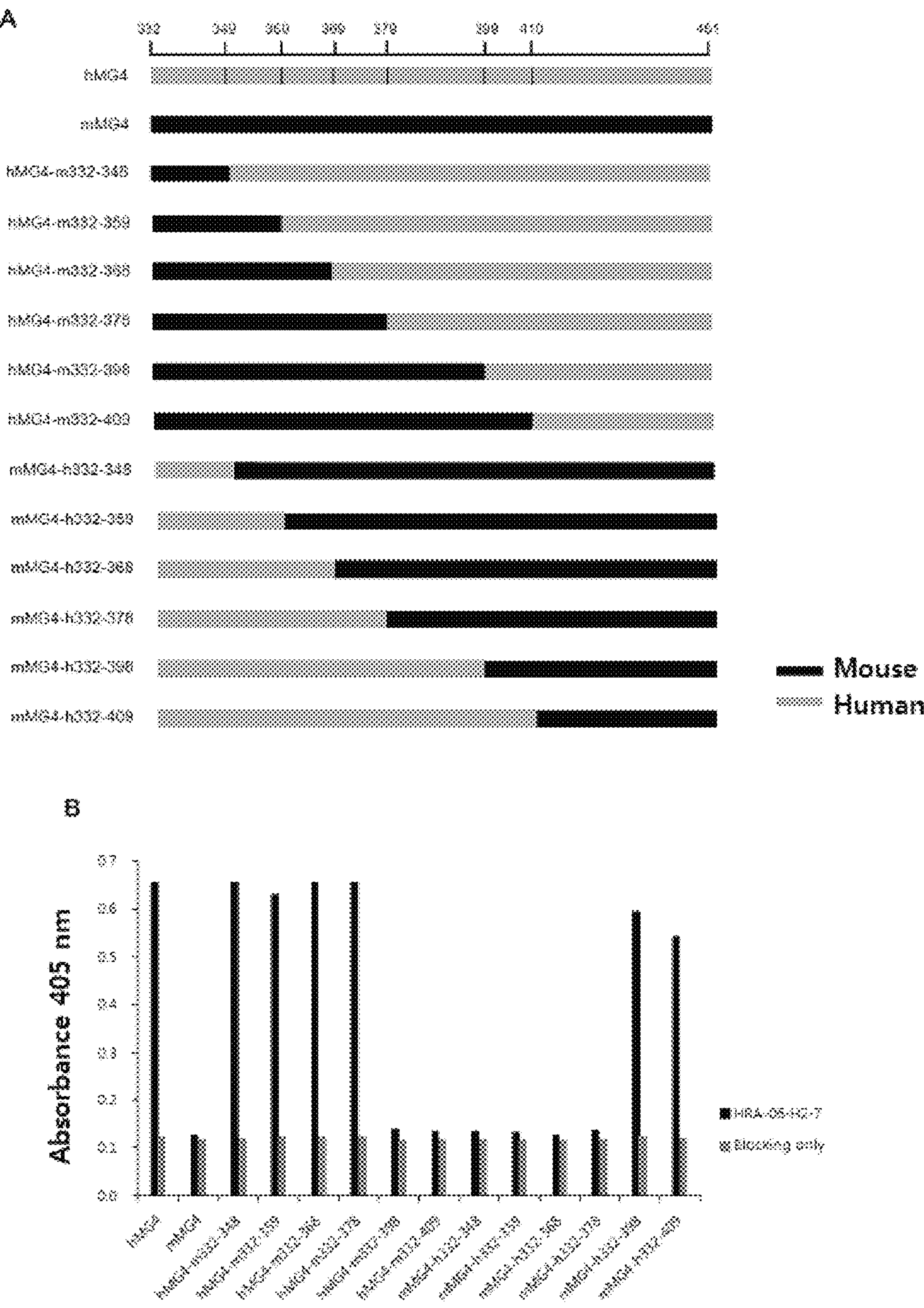
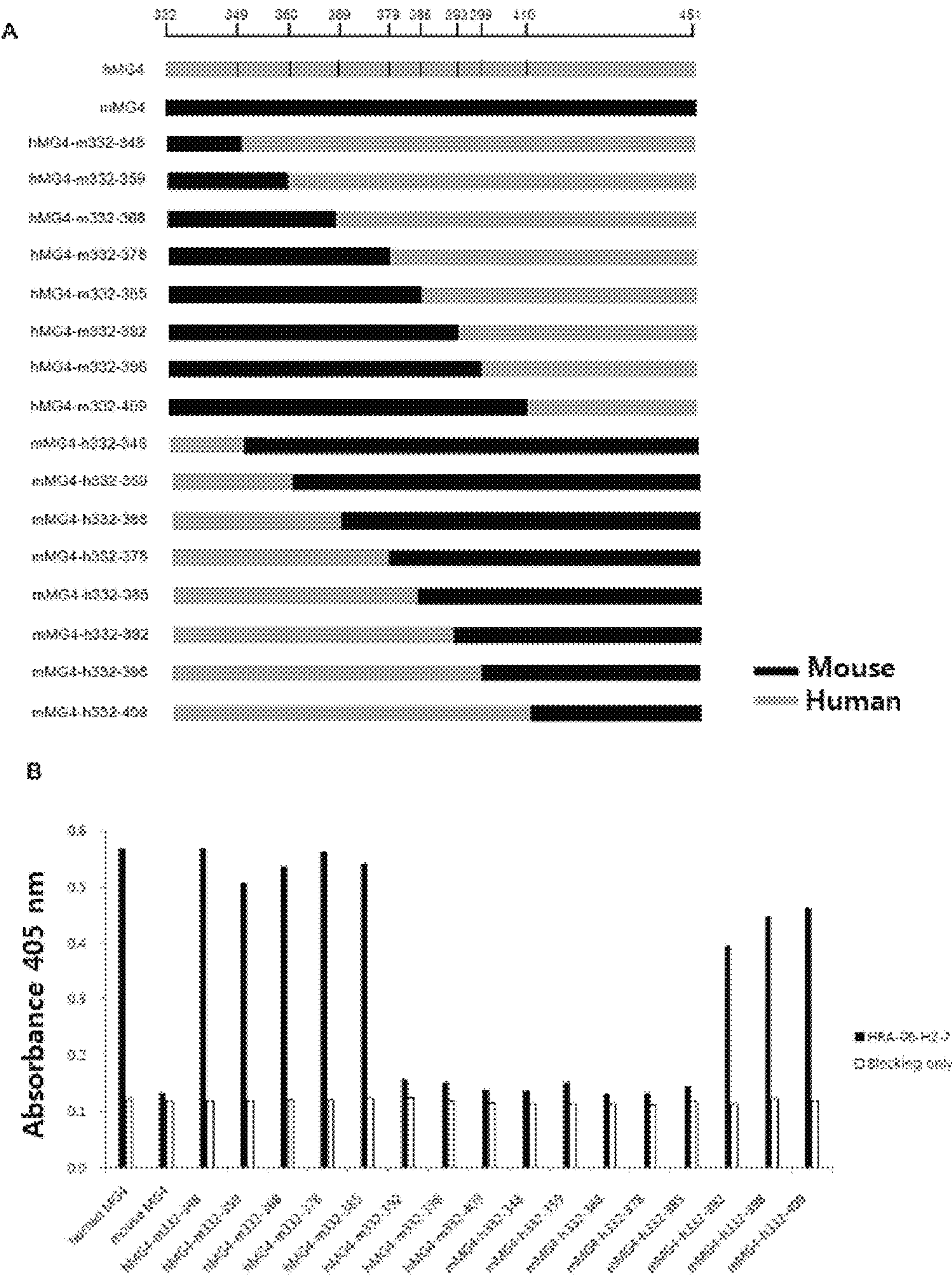


FIG. 14



ANTI-C5 ANTIBODIES AND METHODS OF TREATING COMPLEMENT-RELATED DISEASES

The present application claims priority under 35 U.S.C. § 120 to U.S. Provisional Patent Application Nos. 61/759,015 and 61/862,248, filed on Jan. 31, 2013 and Aug. 5, 2013, respectively, and under 35 U.S.C. § 365 to PCT/KR2014/000920 filed on Feb. 3, 2014, the disclosures of which are incorporated herein by reference.

REFERENCE TO SEQUENCE LISTING SUBMITTED ELECTRONICALLY VIA EFS-WEB

This application contains a sequence listing which is submitted under 37 CFR § 1.821(c) in an electronic form as the text file entitled 113926-29CorrectedSeqList.txt, created on Nov. 20, 2015, the size of which is 92,348 bytes, and the content of which is specifically incorporated by reference into the application.

TECHNICAL FIELD

The present invention relates to an antibody against Complement component 5 (C5), and a method for preventing and treating complement-related diseases using the antibody.

BACKGROUND ART

A complement system plays a first step in innate immunity to most rapidly recognize and destroy an infection source. In addition, the complement system plays an important role in bridging between innate immunity and adaptive immunity by interaction with immune cells. The complement system is activated by a classical pathway, an alternative pathway and a lectin pathway, and then various kinds of complement proteins are activated. The complement proteins activate secretion of inflammatory substances, control an inflammatory response by interaction with immune cells, and effectively eliminate external infection sources by creating materials attacking the infection source, and the like. It is known that since the complement system inhibits an excessive increase in complementary activity by various kinds of complement regulatory proteins, maintains homeostasis, and plays a critical role through various steps of an inflammatory response and an immune response, when complement protein and complement regulatory protein are not properly controlled, various diseases are caused.

When the complement system is activated by the classical pathway, the alternative pathway and the lectin pathway, Complement component 5 (C5) convertase cleaves C5 into C5a and C5b.

C5 is expressed intracellularly as a single pro-C5 peptide of 1676 amino acids consisting of 18 residue signal sequences and an Arg-rich linker sequence (RPRR) between a mature N-terminal β -chain and a C-terminal α -chain. The mature C5 has a molecular weight of about 190 kDa, and consists of two polypeptide chains (α , 115 kDa and β , 75 kDa) which are connected by disulfide bonds. The C5 convertase cleaves C5 between residues 74 and 75 of the alpha chain to release the 74 amino acid C5a peptide and the C5b fragment which are subsequently incorporated into the membrane-attack complex (MAC).

C5a which is anaphylatoxin, directly activates white blood cells and platelets, and functions as a chemotactic

factor of a neutrophil. C5b forms a membrane attack complex together with C6, C7, C8 and C9 in a final step of complement activation to induce hemolysis.

When the complement system is over-activated, since abnormal immune response, and damage of normal cells occur, abnormal activity of the complement system is related with autoimmune diseases, complement-related diseases, and the like. A hemolytic blood disease is a complement-related disease occurring when blood cells are not protected from attack of complement proteins due to genetic defects. It has been reported that complement activation is also related with vigorous immune response and tissue destruction reaction that occur in rheumatoid arthritis, transplant, and the like, and materials such as VEGF are released by tissue damage as well as the immune reaction by the complement activation to cause angiogenesis, which leads to elderly-related macular degeneration and diabetic retinopathy.

That is, the complement system plays an important role in maintaining health; however, it potentially causes diseases or contributes to occurrence of diseases. Accordingly, it is preferable to develop a novel antibody, and the like, of a complement system to be used for treating and diagnosing complement-related diseases.

There are provided a composition comprising a complement inhibitor, a method for treating or preventing complement-related diseases, and a use thereof.

SUMMARY OF INVENTION

Technical Problem

The present invention has been made in an effort to provide a complement C5-binding molecule (for example, a C5-binding antibody or antigen-binding fragment thereof), a pharmaceutical composition comprising the molecule, a method for preparing the molecule and the composition, and a method for using the molecule and the composition, and a use of the molecule and the composition.

In addition, the present invention has been made in an effort to provide an antibody specifically binding to C5 protein, or antigen-binding fragment thereof.

Further, the present invention has been made in an effort to provide a nucleic acid comprising a nucleotide sequence encoding a polypeptide comprising a heavy chain variable region having at least 90%, 95%, 97%, 98% or at least 99% sequence identity to any one selected from SEQ ID NOs: 7, 17, 27, 37, 47 or 57.

In addition, the present invention has been made in an effort to provide a nucleic acid comprising a nucleotide sequence encoding a polypeptide comprising a light chain variable region having at least 90%, 95%, 97%, 98% or at least 99% sequence identity to any one selected from SEQ ID NO: 8, 18, 28, 38, 48 or 58.

Further, the present invention has been made in an effort to provide a vector and a host cell comprising the nucleic acid as described above.

In addition, the present invention has been made in an effort to provide a pharmaceutical composition, comprising: at least one C5-binding molecule (for example, a C5-binding antibody or antigen-binding fragment thereof).

Further, the present invention has been made in an effort to provide a method for treating or diagnosing complement-related diseases, using a C5-binding molecule.

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In addition, the present invention has been made in an effort to provide a kit for diagnosing complement-related diseases comprising: a C5-binding molecule; and a container.

Further, the present invention has been made in an effort to provide a use of the C5-binding molecule in preparing a medicament for treating complement-related diseases.

Further, the present invention has been made in an effort to provide a use of the C5-binding molecule in treating complement-related diseases.

Solution to Problem

An exemplary embodiment of the present invention provides an antibody specifically binding to C5 protein, or antigen-binding fragment thereof. The antibody of the present invention or the antigen-binding fragment thereof may prevent or treat complement-related diseases by inhibiting complement activation by specific binding to C5 protein.

An “antibody” of the present invention includes whole antibodies and any antigen-binding portion or single chains thereof. A naturally occurring “antibody” is a glycoprotein comprising at least two heavy (H) chains and two light (L) chains inter-connected by disulfide bonds. Each heavy chain consists of a heavy chain variable region (V_H) and a heavy chain constant region (C_H). The heavy chain constant region consists of three domains, CH1, CH2 and CH3. Each light chain consists of a light chain variable region (V_L) and a light chain constant region (C_L). The light chain constant region consists of one domain, CL. The VH and VL regions may be further subdivided into regions of hypervariability, referred to as complementarity determining regions (CDR), interspersed with regions that are more conserved, referred to as framework regions (FR). Each VH and VL consists of three CDRs and four FRs arranged from amino-terminus to carboxy-terminus in the following order: FR1, CDR1, FR2, CDR2, FR3, CDR3, FR4. The variable regions of the heavy and light chains contain a binding domain that interacts with an antigen.

In some exemplary embodiments, the antibody or antigen-binding fragment thereof that specifically binds to the C5 protein according to the present invention specifically binds to the beta chain (β -chain) of C5, more specifically, to an MG4 domain of the C5 beta-chain, and more specifically, based on amino acid sequences of the beta chain, to 332nd to 398th amino acid residue sequences, preferably, 332nd to 378th amino acid residue sequences, and more preferably 332nd to 364th amino acid residue sequences, more preferably 332nd to 348th amino acid residue sequences and/or 350th to 420th, preferably, 369th to 409th, more preferably, 379th to 398th, and more preferably, 386th to 392nd amino acid residue sequences. For example, as C5 protein capable of being bound, amino acid sequences of human C5 protein are represented by SEQ ID NO. 61, amino acid sequences of the beta chain of human C5 protein are represented by SEQ ID NO. 62, and amino acid sequences of MG4 domain of the beta chain of human C5 protein are represented by SEQ ID NO. 63. Interspecific cross-reactivity with other species such as rabbits, rats, monkeys, and the like is also provided.

In some exemplary embodiments, the antibody or antigen-binding fragment thereof that specifically binds to the C5 protein according to the present invention has an affinity constant (K_A) of at least $1 \times 10^7 M^{-1}$, $1 \times 10^8 M^{-1}$, $1 \times 10^9 M^{-1}$, $1 \times 10^{10} M^{-1}$, or $1 \times 10^{11} M^{-1}$.

In some exemplary embodiments, the antibody or antigen-binding fragment thereof according to the present invention is antibodies bound to the same epitope as anti-

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bodies shown in Tables 1 to 6 below or antigen-binding fragment thereof, and has at least 90%, 95%, 97%, 98% or at least 99% sequence identity to corresponding sequences. In addition, antibodies having complement inhibiting activity are also included in the scope of the present invention. In addition, in a case of some modifications that are obvious in heavy chain and light chain constant regions, the modifications within a scope in which the same or similar complement inhibitory activity is provided are included in the scope of the present invention. Further, since each of these antibodies is capable of being bound to C5, nucleotide sequences that encode VH, VL, full length heavy chain sequences, and full length light chain sequences (amino acid sequences and nucleotide sequences that encode the amino acid sequences) may be “mixed and matched” to create other C5-binding antibodies of the present invention.

TABLE 1

C5 Antibody (HRA-06-H2-1)	
HRA-06-H2-1	SEQ ID NO and Sequence
CDRH1 CDR1 of Heavy Chain	1. GFSFSGRYWIQ
CDRH2 CDR2 of Heavy Chain	2. SVWPGITGDTNYANWAKG
CDRH3 CDR3 of Heavy Chain	3. EPVAWGGGLDL
CDRL1 CDR1 of Light Chain	4. QASQSINNQLS
CDRL2 CDR2 of Light Chain	5. YASTLAS
CDRL3 CDR1 of Light Chain	6. QGSYYSGGWDYG
VH Variable region of Heavy Chain	7. EVQLVESGGGLVQPGGSLRLSCAASGFS FSGRYWQVVRQAPGKGLEWVASVWPGITGD TNYANWAKGRFTISRDDSKNTLYLQMNSLRA EDTAVYYCAREPVAWGGGLDLWGQGLTIVTS S
VL Variable region of Light Chain	8. DIQMTQSPSSLSASVGDRVTITCQASQS INNQLSWYQQKPGKAPKLLIYYASTLASGYP SRFSGSGSGTDFTLTISLQPEDFATYYCQG SYYSGGWDYGFGQGTKVEIK
Heavy Chain	9. EVQLVESGGGLVQPGGSLRLSCAASGFS FSGRYWQVVRQAPGKGLEWVASVWPGITGD TNYANWAKGRFTISRDDSKNTLYLQMNSLRA EDTAVYYCAREPVAWGGGLDLWGQGLTIVTS SASTKGPSVFPLAPCSRSTSESTAALGCLVK DYFPEPVTVSWNSGALTSGVHTFPAVLQSSG LYSLSSVTVTPSSNFGTQTYTCNVDHKPSNT KVDKTVERKCCVECPPCAPPVAGPSVFLFP PKPKDTLMISRTPEVTCVVVDVSDQEDPEVQF NWYVDGVEVHNAKTKPREEQFNSTYRVVSVL TVLHQDWLNGKEYKCKVSNKGLPSSIEKTI KAKGQPREPQVYTLPPSQEEMTKNQVSLTCL VKGFYPSDIAVEWESNGQPENNYKTTPVLD SDGSFFLYSRLTVDKSRWQEGNVFSCSVME ALHNHYTQKSLSLGLK
Light Chain	10. DIQMTQSPSSLSASVGDRVTITCQASQ SINNQLSWYQQKPGKAPKLLIYYASTLASGV PSRFSGSGSGTDFTLTISLQPEDFATYYCQ GSYYSGGWDYGFGQGTKVEIKRTVAAPSVFI FPPSDEQLKSGTASVCLNNFYPREAKVQW KVDNALQSGNSQESVTEQDSKDSYSTLSSTL TLSKADYEKHKVYACEVTHQGLSPVTKSFN RGEK

TABLE 2

C5 Antibody (HRA-06-H2-7)	
HRA-06-112-7	SEQ ID NO and Sequence
CDRH1	11. GFSFSGRYWIQ
CDRH2	12. SGWPGATGDTNYANWAKG
CDRH3	13. EPVAWGGGLDL
CDRL1	14. QASQSINNQLS
CDRL2	15. YASTLAS
CDRL3	16. QGSYYSGGWDYG
VH	17. EVQLVESGGGLVQPGGSLRLSCAASGFSFSGRYWIQWVRQAPGKGLEWVASGWPGATGDTNYANWAKGRFTISRDDSKNTLYLQMNSLRAEDTAVYYCAREPVAWGGGLDLWGQGTLVTVSS
VL	18. DIQMTQSPSSLSASVGDRVITITCQASQSINNQLSWYQQKPGKAPKLLIYYASTLASGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQGSYYSGGWDYGFGQGGTKVEIK
Heavy Chain	19. EVQLVESGGGLVQPGGSLRLSCAASGFSFSGRYWIQWVRQAPGKGLEWVASGWPGATGDTNYANWAKGRFTISRDDSKNTLYLQMNSLRAEDTAVYYCAREPVAWGGGLDLWGQGTLVTVSSASTKGPSVFPLAPCSRSTSESTAALGCLVKDYFPEPVTVSWNSGALTSGVHTFPAVLQSSGLYSLSSVTVPSSNFGTQTYTCNVDHKPSNTKVDKTVERKCCVECPPCPAPPVAGPSVFLFPPKPKDTLMISRTPEVTCVVVDVSQEDPEVQFNWYVDGVEVHNAKTKPREEQFNSTYRVVSVLTVLHQDWLNGKEYKCKVSNKGLPSSIEKTIKAKGQPREPQVYTLPPSQEEMTKNQVSLTCLVKGFYPSDIAVEWESNGQPENNYKTTPPVLDSDGSFFLYSRLTVDKSRWQEGNVFSCSVMH
Light Chain	20. DIQMTQSPSSLSASVGDRVITITCQASQSINNQLSWYQQKPGKAPKLLIYYASTLASGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQGSYYSGGWDYGFGQGGTKVEIKRTVAAPSVFIFPPSDEQLKSGTASVVCLLNNFYPREAKVQWKVDNALQSGNSQESVTEQDSKSTYSLSSLTLSKADYEKHKVYACEVTHQGLSSPVTKSFNRGEC
C5 Antibody (HRA-06-H2-18)	
HRA-06-H2-18	SEQ ID NO and Sequence
CDRH1	21. GFSFSGRYWIQ
CDRH2	22. SSSLRGTDGTNYANWAKG
CDRH3	23. EPVAWGGGLDL
CDRL1	24. QASQSLNNQLS
CDRL2	25. YASTLAS
CDRL3	26. QGSYYSGGWDYG
VH	27. EVQLVESGGGLVQPGGSLRLSCAASGFSFSGRYWIQWVRQAPGKGLEWVASSSLRGTDGTNYANWAKGRFTISRDDSKNTLYLQMNSLRAEDTAVYYCAREPVAWGGGLDLWGQGTLVTVSS
VL	28. DIQMTQSPSSLSASVGDRVITITCQASQSINNQLSWYQQKPGKAPKLLIYYASTLASGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQGSYYSGGWDYGFGQGGTKVEIK
Heavy Chain	29. EVQLVESGGGLVQPGGSLRLSCAASGFSFSGRYWIQWVRQAPGKGLEWVASSSLRGTDGTNYANWAKGRFTISRDDSKNTLYLQMNSLRAEDTAVYYCAREPVAWGGGLDLWGQGTLVTVSSASTKGPSVFPLAPCSRSTSESTAALGCLVKDYFPEPVTVSWNSGALTSGVHTFPAVLQSSGLYSLSSVTVPSSNFGTQTYTCNV

-continued

C5 Antibody (HRA-06-H2-18)	
HRA-06-H2-18	SEQ ID NO and Sequence
	LVKDYFPEPVTVSWNSGALTSGVHTFPAVLQSSGLYSLSSVTVPSSNFGTQTYTCNVDHKPSNTKVDKTVERKCCVECPPCPAPPVAGPSVFLFPPKPKDTLMISRTPEVTCVVVDVSQEDPEVQFNWYVDGVEVHNAKTKPREEQFNSTYRVVSVLTVLHQDWLNGKEYKCKVSNKGLPSSIEKTIKAKGQPREPQVYTLPPSQEEMTKNQVSLTCLVKGFYPSDIAVEWESNGQPENNYKTTPPVLDSDGSFFLYSRLTVDKSRWQEGNVFSCSVMH
Light Chain	30. DIQMTQSPSSLSASVGDRVITITCQASQSINNQLSWYQQKPGKAPKLLIYYASTLASGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQGSYYSGGWDYGFGQGGTKVEIKRTVAAPSVFIFPPSDEQLKSGTASVVCLLNNFYPREAKVQWKVDNALQSGNSQESVTEQDSKSTYSLSSLTLSKADYEKHKVYACEVTHQGLSSPVTKSFNRGEC

TABLE 4

C5 Antibody (HRA-06-H2-24)	
HRA-06-H2-24	SEQ ID NO and Sequence
CDRH1	31. GFSFSGRYWIQ
CDRH2	32. SVWPGFTGDTNYANWAKG
CDRH3	33. EPVAWGGGLDL
CDRL1	34. QASQSINNQLS
CDRL2	35. YASTLAS
CDRL3	36. QGSYYSGGWDYG
VH	37. EVQLVESGGGLVQPGGSLRLSCAASGFSFSGRYWIQWVRQAPGKGLEWVASVWPGFTGDTNYANWAKGRFTISRDDSKNTLYLQMNSLRAEDTAVYYCAREPVAWGGGLDLWGQGTLVTVSS
VL	38. DIQMTQSPSSLSASVGDRVITITCQASQSINNQLSWYQQKPGKAPKLLIYYASTLASGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQGSYYSGGWDYGFGQGGTKVEIK
Heavy Chain	39. EVQLVESGGGLVQPGGSLRLSCAASGFSFSGRYWIQWVRQAPGKGLEWVASVWPGFTGDTNYANWAKGRFTISRDDSKNTLYLQMNSLRAEDTAVYYCAREPVAWGGGLDLWGQGTLVTVSSGALTSGVHTFPAVLQSSGLYSLSSVTVPSSNFGTQTYTCNVDHKPSNTKVDKTVERKCCVECPPCPAPPVAGPSVFLFPPKPKDTLMISRTPEVTCVVVDVSQEDPEVQFNWYVDGVEVHNAKTKPREEQFNSTYRVVSVLTVLHQDWLNGKEYKCKVSNKGLPSSIEKTIKAKGQPREPQVYTLPPSQEEMTKNQVSLTCLVKGFYPSDIAVEWESNGQPENNYKTTPPVLDSDGSFFLYSRLTVDKSRWQEGNVFSCSVMH
Light Chain	40. DIQMTQSPSSLSASVGDRVITITCQASQSINNQLSWYQQKPGKAPKLLIYYASTLASGVPSRFSGSGSGTDFTLTISSLQPEDFATYYCQGSYYSGGWDYGFGQGGTKVEIKRTVAAPSVFIFPPSDEQLKSGTASVVCLLNNFYPREAKVQWKVDNALQSGNSQESVTEQDSKSTYSLSSLTLSKADYEKHKVYACEVTHQGLSSPVTKSFNRGEC

TABLE 5

C5 Antibody (HRA-06-H1-9-H2-7)	
HRA-06-H1-9-H2-7	SEQ ID NO and Sequence
CDRH1	41.GFSLSGRYWIQ
CDRH2	42.SGWPGATGDTNYANWAKG
CDRH3	43.EPVAWGGLDL
CDRL1	44.QASQSINNQLS
CDRL2	45.YASTLAS
CDRL3	46.QGSYYSGGWDYG
VH	47.EVQLVESGGGLVQPGGSLRLSCAASGFSLSGRYWIQWV RQAPGKGLEWVASGWPGATGDTNYANWAKGRFTISRDD SKNTLYLQMNSLRAEDTAVYYCAREPVAWGGLDLWGQ GTLVTVSS
VL	48.DIQMTQSPSSLSASVGDRVITTCQASQSINNQLSWYQQK PGKAPKLLIYYASTLASGVPSRFGSGSGTDFTLTISLQPE DFATYYCQGSYYSGGWDYGFGQGQTKVEIK
Heavy Chain	49.EVQLVESGGGLVQPGGSLRLSCAASGFSLSGRYWIQWV RQAPGKGLEWVASGWPGATGDTNYANWAKGRFTISRDD SKNTLYLQMNSLRAEDTAVYYCAREPVAWGGLDLWGQ GTLVTVSSASTKGPSVFPLAPCSRSTSESTAALGCLVKDYF PEPVTVSWNSGALTSGVHTFPAVLQSSGLYSLSSVVTVPSS NFGTQTYTCNVDHKPSNTKVDKTKVERKCCVECPPCAPPV AGPSVFLFPPKPKDTLMI SRTPEVTCVVVDVSQEDPEVQFN WYVDGVEVHNAKTKPREEQFNSTYRVVSVLTVLHQDWL NGKEYKCKVSNKGLPSSIEKTISKAKGQPREPQVYTLPPSQ EEMTKNQVSLTCLVKGFYPSDIAVEWESNGQPENNYKTTP PVLDSGSEFFLYSRLTVDKSRWQEGNVFSCSVMEALHN HYTQKSLSLSLGK
Light Chain	50.DIQMTQSPSSLSASVGDRVITTCQASQSINNQLSWYQQK PGKAPKLLIYYASTLASGVPSRFGSGSGTDFTLTISLQPE DFATYYCQGSYYSGGWDYGFGQGQTKVEIKRTVAAPSVFIF PPSDEQLKSGTASVVCLLNNFYPREAKVQWKVDNALQSG NSQESVTEQDSKDSYSLSSLTLSKADYEKHKVYACEVT HQGLSSPVTKSFNRGEC

TABLE 6

C5 Antibody (HRA-06-H1-9-H2-24)	
HRA-06-H1-9-H2-24	SEQ ID NO and Sequence
CDRH1	51.GFSLSGRYWIQ
CDRH2	52.SVWPGFTGDTNYANWAKG
CDRH3	53.EPVAWGGLDL
CDRL1	54.QASQSINNQLS
CDRL2	55.YASTLAS
CDRL3	56.QGSYYSGGWDYG
VH	57.EVQLVESGGGLVQPGGSLRLSCAASGFSLSGRYWIQWV RQAPGKGLEWVASVWPGFTGDTNYANWAKGRFTISRDDS KNTLYLQMNSLRAEDTAVYYCAREPVAWGGLDLWGQG TLVTVSS
VL	58.DIQMTQSPSSLSASVGDRVITTCQASQSINNQLSWYQQK PGKAPKLLIYYASTLASGVPSRFGSGSGTDFTLTISLQPE DFATYYCQGSYYSGGWDYGFGQGQTKVEIK

TABLE 6-continued

C5 Antibody (HRA-06-H1-9-H2-24)	
HRA-06-H1-9-H2-24	SEQ ID NO and Sequence
Heavy Chain	59.EVQLVESGGGLVQPGGSLRLSCAASGFSLSGRYWIQWV RQAPGKGLEWVASVWPGFTGDTNYANWAKGRFTISRDDS KNTLYLQMNSLRAEDTAVYYCAREPVAWGGLDLWGQG TLVTVSSASTKGPSVFPLAPCSRSTSESTAALGCLVKDYFPE PVTVSWNSGALTSGVHTFPAVLQSSGLYSLSSVVTVPSSNF GTQTYTCNVDHKPSNTKVDKTKVERKCCVECPPCAPPVAG PSVFLFPPKPKDTLMI SRTPEVTCVVVDVSQEDPEVQFNWY VDGVEVHNAKTKPREEQFNSTYRVVSVLTVLHQDWLNGK EYKCKVSNKGLPSSIEKTISKAKGQPREPQVYTLPPSQEEM TKNQVSLTCLVKGFYPSDIAVEWESNGQPENNYKTTPVL DSDGSFFLYSRLTVDKSRWQEGNVFSCSVMEALHNHYT QKSLSLSLGK
Light Chain	60.DIQMTQSPSSLSASVGDRVITTCQASQSINNQLSWYQQK PGKAPKLLIYYASTLASGVPSRFGSGSGTDFTLTISLQPE DFATYYCQGSYYSGGWDYGFGQGQTKVEIKRTVAAPSVFIF PPSDEQLKSGTASVVCLLNNFYPREAKVQWKVDNALQSG NSQESVTEQDSKDSYSLSSLTLSKADYEKHKVYACEVT HQGLSSPVTKSFNRGEC

25 The antibody of the present invention is prepared by using all antibodies comprising amino acids that are identical to antibodies shown in Tables 1 to 6; antibodies having heavy chain variable regions comprising CDR1, CDR2 and CDR3 sequences, and light chain variable regions comprising CDR1, CDR2 and CDR3 sequences, wherein at least one of the CDR sequences has the antibody described in the present invention or specific amino acid sequences based on conservative modifications thereof; antibodies having functional properties of the C5-binding antibody of the present invention; antibodies bound to the same epitope as the antibodies shown in Tables 1 to 6; antibodies having at least one VH and/or VL sequences described in the present invention as a starting material to engineer a modified antibody, and includes all of antibodies having properties which are partially modified from the starting antibody, comprising the above-mentioned antibodies.

30 In addition, the antibody of the present invention includes those in which modifications have been made to framework residues within VH and/or VL, in order to improve properties of the antibody.

35 Further, the antibody of the present invention may be a fully human antibody specifically bound to a C5 protein. When compared to chimeric antibodies, and the like, the antibody of the present invention may have further reduced antigenicity when administered to human subjects. A human antibody includes heavy or light chain variable regions or full length heavy or light chains that are the products of or derived from a particular germline sequence if the variable regions or full length chains of the antibody are obtained from a system that uses human germline immunoglobulin genes. Such systems include immunizing a transgenic mouse carrying human immunoglobulin genes with the antigen of interest or screening a human immunoglobulin gene library displayed on phage with the antigen of interest. A human antibody that is “the product of” or “derived from” a human germline immunoglobulin sequence may be identified as such by comparing the amino acid sequence of the human antibody with the amino acid sequences of human germline immunoglobulins and selecting the human germline immunoglobulin sequence that is closest in sequence to the sequence of the human antibody.

40 In addition, the antibody of the present invention may be a bispecific or a multispecific antibody. The antibody of the

present invention or the antigen-binding fragment thereof may be bispecific molecules that are bound to more than two different binding sites or target molecules.

In some exemplary embodiments, the antibody of the present invention may be a monoclonal antibody specifically bound to the C5 protein. For example, the antibody of the present invention may be a human or humanized monoclonal antibody or a chimeric antibody that specifically binds to the C5 protein, and includes a human heavy chain constant region and a human light chain constant region. In addition, the antibody of the present invention may be a single chain antibody, and may be a Fab fragment, a single-chain variable fragment (scFv), and IgG isotype. Preferable IgG isotopes include IgG2, IgG4 and/or IgG2/4. In some exemplary embodiments, the IgG isotype of the present invention is IgG2/4. IgG2/4 hybrid constant region may have a form in which CH1 and a hinge region of IgG2 are fused with CH2 and CH3 regions of IgG4.

The monoclonal antibody may be produced by general methods for producing monoclonal antibodies, and may be expressed and purified by inserting a synthesized antibody gene into a vector for expressing an antibody, preferably, pcDNA, pCI, pCMV, pCEP4, and the like. In addition, the monoclonal antibody may be produced by using viral or carcinogenic transformation of B lymphocytes, or on the basis of sequence of a murine monoclonal antibody produced using a murine system. For example, DNA encoding heavy chain and light chain immunoglobulin may be obtained from murine hybridoma and may contain non-murine immunoglobulin sequences together therewith, by standard molecular biology techniques. In addition, the human monoclonal antibody against C5 may be produced by using transgenic or transchromosomal mice having a part of a human immune system rather than a mouse immune system.

In some exemplary embodiments, the present invention provides an antibody or antigen-binding fragment thereof comprising a framework in which amino acids are substituted into an antibody framework from the respective human VH or VL germline sequences.

In some exemplary embodiments, the antibody or antigen-binding fragment thereof that specifically binds to the C5 protein according to the present invention includes at least one complementarity determining region (CDR) sequence having at least 95% sequence identity to SEQ ID NO: 1, 2, 3, 4, 5, 6, 11, 12, 21, 22, 31, 32, 41, 42, 51 or 52.

In some exemplary embodiments, the antibody or antigen-binding fragment thereof that specifically binds to the C5 protein according to the present invention includes at least one heavy chain complementarity determining region sequence as the same as SEQ ID NO: 1, 2, 3, 11, 12, 21, 22, 31, 32, 41, 42, 51 or 52.

In some exemplary embodiments, the antibody or antigen-binding fragment thereof that specifically binds to the C5 protein according to the present invention includes at least one light chain complementarity determining region sequence as the same as SEQ ID NO: 4, 5, or 6.

In some exemplary embodiments, the antibody or antigen-binding fragment thereof that specifically binds to the C5 protein according to the present invention includes any one heavy chain complementarity determining region 1 (CDR1) selected from SEQ ID NO: 1, 11, 21, 31, 41 or 51, any one heavy chain complementarity determining region 2 (CDR2) selected from SEQ ID NO: 2, 12, 22, 32, 42 or 52, and/or any one heavy chain CDR3 selected from SEQ ID NO: 3, 13, 23, 33, 43 or 53.

In some exemplary embodiments, the antibody or antigen-binding fragment thereof that specifically binds to the C5 protein according to the present invention includes light chain CDR1 of SEQ ID NO: 4, light chain CDR2 of SEQ ID NO: 5, and/or light chain CDR3 of SEQ ID NO: 6.

In some exemplary embodiments, the antibody or antigen-binding fragment thereof that specifically binds to the C5 protein according to the present invention includes any one heavy chain variable region selected from SEQ ID NO: 7, 17, 27, 37, 47 or 57, or includes a heavy chain variable region having at least 90%, 95%, 97%, or at least 99% sequence identity to any one heavy chain variable region selected from SEQ ID NO: 7, 17, 27, 37, 47 or 57.

In some exemplary embodiments, the antibody or antigen-binding fragment thereof that specifically binds to the C5 protein according to the present invention includes a light chain variable region of SEQ ID NO: 8 or includes a light chain variable region having at least 90%, 95%, 97% or at least 99% sequence identity to the light chain variable region of SEQ ID NO: 8.

In some exemplary embodiments, the antibody or antigen-binding fragment thereof that specifically binds to the C5 protein according to the present invention includes any one heavy chain selected from SEQ ID NO: 9, 19, 29, 39, 49 or 59, or includes a heavy chain variable region having at least 90%, 95%, 97%, or at least 99% sequence identity to any one heavy chain selected from SEQ ID NO: 9, 19, 29, 39, 49 or 59.

In some exemplary embodiments, the antibody or antigen-binding fragment thereof that specifically binds to the C5 protein according to the present invention includes a light chain of SEQ ID NO: 10, or includes a light chain having at least 90%, 95%, 97% or at least 99% sequence identity to the light chain of SEQ ID NO: 10.

In some exemplary embodiments, the antibody or antigen-binding fragment thereof that specifically binds to the C5 protein according to the present invention includes those bound to an epitope in the beta chain of the C5 protein of SEQ ID No. 62. In detail, the epitope may correspond to 332nd to 398th amino acid residue sequences, preferably, 332nd to 378th, more preferably, 332nd to 364th, and much more preferably, 332nd to 348th, and/or 350th to 420th, preferably, 369th to 409th, more preferably, 379th to 398th, and much more preferably, 386th to 392nd amino acid residue sequences, based on the beta chain amino acid sequence of the C5 protein.

In addition, the present invention provides a nucleic acid comprising a nucleotide sequence encoding a polypeptide comprising a heavy chain variable region having at least 90%, 95%, 97%, 98% or at least 99% sequence identity to any one selected from SEQ ID NO: 7, 17, 27, 37, 47 or 57.

In some exemplary embodiments, the nucleic acid comprising a nucleotide sequence encoding a polypeptide comprising a heavy chain variable region of the present invention has sequences shown in Table 7 below or has at least 90%, 95%, 97%, 98% or at least 99% sequence identity to any one sequence thereof.

TABLE 7

Nucleotide Sequence Encoding Heavy Chain Variable Region														
Variable region of Heavy chan SEQ ID NO and Sequence														
HRA-06-H2-1	64.	GAG	GTG	CAG	CTG	GTG	GAG	TCT	GGC	GGC				
		GGA	CTG	GTG	CAG	CCT	GGC	GGA	AGC	TTG	CGG			
		CTG	TCC	TGC	GCC	GCC	TCC	GGA	TTC	TCC	TTC	AGT		
		GGC	AGG	TAC	TGG	ATA	CAA	TGG	GTG	CGG	CAG			
		GCC	CCT	GGC	AAG	GGC	CTC	GAG	TGG	GTG	GCC			
		TCT	GTG	TGG	CCT	GGT	ATT	ACT	GGT	GAC	ACT			
		AAC	TAC	GCG	AAC	TGG	GCG	AAA	GGC	CGG	TTC			
		ACC	ATC	TCC	CGG	GAC	GAC	TCC	AAG	AAC	ACC			
		CTG	TAC	CTG	CAG	ATG	AAC	TCC	CTG	CGG	GCC			
		GAG	GAC	ACC	GCC	GTG	TAC	TAC	TGC	GCC	AGA			
		GAA	CCT	GTT	GCC	TGG	GGT	GGC	GGC	TTG	GAC			
		TTG	TGG	GGC	CAG	GGC	ACA	CTA	GTG	ACC	GTG			
		TCC	TCC											
HRA-06-H2-7	65.	GAG	GTG	CAG	CTG	GTG	GAG	TCT	GGC	GGC				
		GGA	CTG	GTG	CAG	CCT	GGC	GGA	AGC	TTG	CGG			
		CTG	TCC	TGC	GCC	GCC	TCC	GGA	TTC	TCC	TTC	AGT		
		GGC	AGG	TAC	TGG	ATA	CAA	TGG	GTG	CGG	CAG			
		GCC	CCT	GGC	AAG	GGC	CTC	GAG	TGG	GTG	GCC			
		AGT	GGT	TGG	CCG	GGG	GCG	ACT	GGT	GAC	ACT			
		AAC	TAC	GCG	AAC	TGG	GCG	AAA	GGC	CGG	TTC			
		ACC	ATC	TCC	CGG	GAC	GAC	TCC	AAG	AAC	ACC			
		CTG	TAC	CTG	CAG	ATG	AAC	TCC	CTG	CGG	GCC			
		GAG	GAC	ACC	GCC	GTG	TAC	TAC	TGC	GCC	AGA			
		GAA	CCT	GTT	GCC	TGG	GGT	GGC	GGC	TTG	GAC			
		TTG	TGG	GGC	CAG	GGC	ACA	CTA	GTG	ACC	GTG			
		TCC	TCC											
HRA-06-H2-18	66.	GAG	GTG	CAG	CTG	GTG	GAG	TCT	GGC	GGC				
		GGA	CTG	GTG	CAG	CCT	GGC	GGA	AGC	TTG	CGG			
		CTG	TCC	TGC	GCC	GCC	TCC	GGA	TTC	TCC	TTC	AGT		
		GGC	AGG	TAC	TGG	ATA	CAA	TGG	GTG	CGG	CAG			
		GCC	CCT	GGC	AAG	GGC	CTC	GAG	TGG	GTG	GCC			
		AGT	TCT	AGT	TTG	CGG	GGG	ACT	GGT	GAC	ACT			
		AAC	TAC	GCG	AAC	TGG	GCG	AAA	GGC	CGG	TTC			
		ACC	ATC	TCC	CGG	GAC	GAC	TCC	AAG	AAC	ACC			
		CTG	TAC	CTG	CAG	ATG	AAC	TCC	CTG	CGG	GCC			
		GAG	GAC	ACC	GCC	GTG	TAC	TAC	TGC	GCC	AGA			
		GAA	CCT	GTT	GCC	TGG	GGT	GGC	GGC	TTG	GAC			
		TTG	TGG	GGC	CAG	GGC	ACA	CTA	GTG	ACC	GTG			
		TCC	TCC											
HRA-06-H2-24	67.	GAG	GTG	CAG	CTG	GTG	GAG	TCT	GGC	GGC				
		GGA	CTG	GTG	CAG	CCT	GGC	GGA	AGC	TTG	CGG			
		CTG	TCC	TGC	GCC	GCC	TCC	GGA	TTC	TCC	TTC	AGT		
		GGC	AGG	TAC	TGG	ATA	CAA	TGG	GTG	CGG	CAG			
		GCC	CCT	GGC	AAG	GGC	CTC	GAG	TGG	GTG	GCC			
		TCG	GTG	TGG	CCG	GGG	TTT	ACT	GGT	GAC	ACT			
		AAC	TAC	GCG	AAC	TGG	GCG	AAA	GGC	CGG	TTC			
		ACC	ATC	TCC	CGG	GAC	GAC	TCC	AAG	AAC	ACC			
		CTG	TAC	CTG	CAG	ATG	AAC	TCC	CTG	CGG	GCC			
		GAG	GAC	ACC	GCC	GTG	TAC	TAC	TGC	GCC	AGA			
		GAA	CCT	GTT	GCC	TGG	GGT	GGC	GGC	TTG	GAC			
		TTG	TGG	GGC	CAG	GGC	ACA	CTA	GTG	ACC	GTG			
		TCC	TCC											
HRA-06-H1-9-H2-7	68.	GAG	GTG	CAG	CTG	GTG	GAG	TCT	GGC	GGC				
		GGA	CTG	GTG	CAG	CCT	GGC	GGA	AGC	TTG	CGG			
		CTG	TCC	TGC	GCC	GCC	TCC	GGA	TTC	TCC	CTC	AGT		
		GGC	AGG	TAC	TGG	ATA	CAA	TGG	GTG	CGG	CAG			
		GCC	CCT	GGC	AAG	GGC	CTC	GAG	TGG	GTG	GCC			
		AGT	GGT	TGG	CCG	GGG	GCG	ACT	GGT	GAC	ACT			
		AAC	TAC	GCG	AAC	TGG	GCG	AAA	GGC	CGG	TTC			
		ACC	ATC	TCC	CGG	GAC	GAC	TCC	AAG	AAC	ACC			
		CTG	TAC	CTG	CAG	ATG	AAC	TCC	CTG	CGG	GCC			
		GAG	GAC	ACC	GCC	GTG	TAC	TAC	TGC	GCC	AGA			
		GAA	CCT	GTT	GCC	TGG	GGT	GGC	GGC	TTG	GAC			
		TTG	TGG	GGC	CAG	GGC	ACA	CTA	GTG	ACC	GTG			
		TCC	TCC											
HRA-06-H1-9-H2-24	69.	GAG	GTG	CAG	CTG	GTG	GAG	TCT	GGC	GGC				
		GGA	CTG	GTG	CAG	CCT	GGC	GGA	AGC	TTG	CGG			
		CTG	TCC	TGC	GCC	GCC	TCC	GGA	TTC	TCC	CTC	AGT		
		GGC	AGG	TAC	TGG	ATA	CAA	TGG	GTG	CGG	CAG			
		GCC	CCT	GGC	AAG	GGC	CTC	GAG	TGG	GTG	GCC			
		TCG	GTG	TGG	CCG	GGG	TTT	ACT	GGT	GAC	ACT			

TABLE 7-continued

Nucleotide Sequence Encoding Heavy Chain Variable Region										
Variable region of Heavy chan SEQ ID NO and Sequence										
AAC	TAC	GCG	AAC	TGG	GCG	AAA	GGC	CGG	TTC	
ACC	ATC	TCC	CGG	GAC	GAC	TCC	AAG	AAC	ACC	
CTG	TAC	CTG	CAG	ATG	AAC	TCC	CTG	CGG	GCC	
GAG	GAC	ACC	GCC	GTG	TAC	TAC	TGC	GCC	AGA	
GAA	CCT	GTT	GCC	TGG	GGT	GGC	GGC	TTG	GAC	
TTG	TGG	GGC	CAG	GGC	ACA	CTA	GTG	ACC	GTG	
TCC	TCC									

In addition, the present invention provides a nucleic acid comprising a nucleotide sequence encoding a polypeptide comprising a light chain variable region having at least 90%, 95%, 97%, 98% or at least 99% sequence identity to SEQ ID NO: 8. In some exemplary embodiments, the nucleic acid comprising a nucleotide sequence encoding a polypeptide comprising a light chain variable region of the present invention has sequences shown in Table 8 below or has at least 90%, 95%, 97%, 98% or at least 99% sequence identity to any one sequence thereof.

TABLE 8

Nucleotide Sequence Encoding Light Chain Variable Region										
Variable region of Light chain SEQ ID NO and Sequence										
70.	GAC	ATC	CAG	ATG	ACC	CAG	TCC	CCC	TCC	TCG
	CTG	AGC	GCC	TCC	GTG	GGC	GAC	CGG	GTG	ACC
	ATC	ACC	TGC	CAG	GCC	AGT	CAG	AGC	ATT	AAC
	AAC	CAA	CTA	TCC	TGG	TAT	CAG	CAG	AAG	CCT
	GGC	AAG	GCG	CCT	AAG	CTG	CTG	ATC	TAC	TAT
	GCA	TCC	ACT	CTG	GCA	TCT	GGC	GTG	CCT	TCC
	CGG	TTC	TCC	GGA	TCC	GGC	TCC	GGC	ACC	GAC
	TTC	ACC	CTG	ACC	ATC	TCC	TCC	CTG	CAA	CCT
	GAG	GAC	TTC	GCC	ACC	TAC	TAC	TGC	CAA	GGC
	AGT	TAT	TAT	AGT	GGT	GGT	TGG	GAC	TAT	GGT
	TTC	GGC	CAG	GGT	ACC	AAG	GTG	GAG	ATC	AAG

Further, the present invention provides a vector and a host cell comprising the nucleic acid as described above. In one exemplary embodiment, the present invention provides a host cell comprising (1) a recombinant DNA segment encoding the heavy chain of the antibody of the present invention, and (2) a second recombinant DNA segment encoding the light chain of the antibody of the present invention. In another exemplary embodiment, the present invention provides a host cell comprising a recombinant DNA segment encoding each of the heavy chain and the light chain of the antibody of the present invention. In some exemplary embodiment, the antibody or the antigen-binding fragment thereof is a human monoclonal antibody or antigen-binding fragment thereof.

In order to express polynucleotide encoding a C5-binding antibody, chain, or binding fragment thereof, various expression vector may be used, and in order to produce antibodies in mammalian host cells, both of virus-based and non-viral expression vector may be used. Vectors such as pcDNA, pCI, pCMV, pCEP4, and the like, and host cells such as HEK293, CHO, CHO-DG44, and the like, may be used.

The host cell for harboring and expressing the C5-binding antibody may be an eukaryotic cell or a prokaryotic cell. *E. Coli*, preferably, *E. coli* ER2738. HB2151, BL21, and the like, may be included as examples, which are eukaryotic host cells useful for cloning and expressing the polynucleotide of the present invention. Other microbial host cells

suitable for being used include *bacillus*, such as *Bacillus subtilis*, and other enteric bacteria, such as *Salmonella*, *Serratia* and various *Pseudomonas* species. Other microbes, such as yeast, are capable of being employed to express C5-binding polypeptide of the present invention, and insect cells in combination with baculovirus vectors may also be used.

In some preferred exemplary embodiments, mammalian host cells are used to express and produce the C5-binding polypeptide of the present invention. For example, they may

be either a hybridoma cell line expressing endogenous immunoglobulin genes or a mammalian cell line harboring an exogenous expression vector. In addition, for example, as any animal or human cell, a number of suitable host cell lines capable of secreting immunoglobulin comprising CHO cell lines, Cos cell lines, HeLa cells, myeloma cell lines, HEK cell lines, transformed B-cells and hybridomas may be used, preferably, HEK293, CHO, CHO-DG44 may be used.

Further, the present invention provides a pharmaceutical composition, comprising: at least one C5-binding molecule (for example, a C5-binding antibody or antigen-binding fragment thereof).

The pharmaceutical composition of the present invention is effective for treating complement-related diseases. The complement-related diseases include all diseases and pathological conditions in which onset of the diseases is related with abnormality of activation of the complement system, for example, complement deficiency. For example, the complement-related diseases include inflammatory diseases and autoimmune diseases, such as rheumatoid arthritis (RA), osteoarthritis, acute respiratory distress syndrome (ARDS), remote tissue injury after ischemia and reperfusion, complement activation during cardiopulmonary bypass surgery, dermatomyositis, pemphigus, lupus nephritis, glomerulonephritis, renal vasculitis, cardiopulmonary by-pass, heart failure-induced coronary endothelial dysfunction, type II membrane-proliferative glomerulonephritis, acute renal failure,

antiphospholipid syndrome, macular degeneration, endophthalmitis, new blood vessel disease, allograft transplantation, hyperacute rejection, hemodialysis, chronic obstructive pulmonary disorder (COPD) respiratory distress syndrome, asthma, paroxymal nocturnal hemoglobinuria (PNH) and aspiration pneumonia, but the present invention is not limited thereto.

The composition may additionally contain one or more other therapeutic agents that are suitable for treating or preventing complement-related diseases. Pharmaceutical carriers enhance or stabilize the composition, or facilitate preparation of the composition. Pharmaceutically acceptable carriers include solvents, dispersion media, coating materials, antibacterial and antifungal agents, isotonic and absorption delaying agents, and the like that are physiologically compatible.

The pharmaceutical composition of the present invention may be administered by a variety of methods known in the art. The route and/or mode of administration vary depending upon the desired results. It is preferred that administration may be intravenous, intramuscular, intraperitoneal, or subcutaneous, or administered proximal to the site of the target. In a specific exemplary embodiment, the antibodies of the present invention are formulated so that they can be administered intravitreally into the eye. Depending on the route of administration, active compounds, that is, antibody, bispecific and multispecific molecules, may be coated with a material to protect the compound from the action of acids and other natural conditions that may inactivate the compound.

The composition needs to be sterile and fluid. Proper fluidity may be maintained, for example, by using the coating materials such as lecithin, or by maintaining required particle size in the case of dispersion liquid and by using surfactants. In many cases, it is preferable to include isotonic agents, for example, sugars, polyalcohols such as mannitol or sorbitol, and sodium chloride in the composition. Long-term absorption of the injectable compositions may be brought about by comprising an agent which delays absorption, for example, aluminum monostearate or gelatin in the composition.

The pharmaceutical composition of the present invention may be prepared in accordance with methods well known and routinely practiced in the art. See, e.g., [Remington: The Science and Practice of Pharmacy, Mack Publishing Co., 20th ed., 2000] and [Sustained and Controlled Release Drug Delivery Systems, J. R. Robinson, ed., Marcel Dekker, Inc., New York, 1978]. The pharmaceutical composition is preferably prepared under GMP conditions. Typically, a therapeutically effective dose or efficacious dose of the C5-binding antibody is employed in the pharmaceutical composition of the present invention. The C5-binding antibodies are formulated into pharmaceutically acceptable dosage forms by conventional methods known to those of skill in the art. Dosage regimens are adjusted to provide the optimum desired response (e.g., a therapeutic response).

Actual dosage levels of the active ingredients in the pharmaceutical compositions of the present invention can be varied so as to obtain an amount of the active ingredient which is effective to achieve the desired therapeutic response for a particular patient, composition, and mode of administration, without being toxic to the patient. The selected dosage level depends on a variety of pharmacokinetic factors, for example, activity of the particular compositions of the present invention employed, or an ester, a salt or an amide thereof, the route of administration, the time of administration, the rate of excretion of the particular com-

pound being employed, the duration of the treatment, other drugs, compounds and/or materials used in combination with the particular compositions employed, the age, sex, weight, condition, general health and prior medical history of the patient being treated, and other factors.

Treatment dosages need to be titrated to optimize safety and efficacy. For systemic administration with an antibody, the dosage ranges from about 0.0001 to 100 mg/kg, and more usually 0.01 to 15 mg/kg, of the host body weight. An exemplary treatment regime entails systemic administration once per every two weeks or once a month or once every 3 to 6 months. For intravitreal administration with an antibody, the dosage ranges from about 0.0001 to about 10 mg. An exemplary treatment regime entails systemic administration once per every two weeks or once a month or once every 3 to 6 months.

In some methods of systemic administration, dosage is adjusted to achieve a plasma antibody concentration of 1-1000 µg/ml and in some methods 25-500 µg/ml. Alternatively, antibody can be administered as a sustained release formulation, in the case in which less frequent administration is required. Dosage and frequency vary depending on the half-life of the antibody in the patient. In prophylactic applications, a relatively low dosage is administered at relatively infrequent intervals over a long period of time.

Further, the present invention provides a method for treating or diagnosing complement-related diseases, using a C5-binding molecule.

The method for treating complement-related diseases using a C5-binding molecule of the present invention includes: administering a therapeutically effective amount of the antibody or antigen-binding fragment thereof or a composition comprising the same. Term "therapeutically effective amount" used in the present invention indicates an amount of the C5-binding molecule of the present invention or an amount of the composition comprising the C5-binding molecule of the present invention which is effective for preventing or treating complement-related diseases.

When the C5-binding molecule or the composition comprising the same is administered in combination with another agent as a therapeutic agent of the present invention, these two materials may be administered sequentially or simultaneously in any order. Suitable agents for combination treatment with C5-binding antibodies include agents known in the art that are able to modulate activities of complement components. For example, the agents include phosphonate esters, polyanionic substances, sulfonyl fluorides, polynucleotides, pimaric acids, several antiinflammatories, and the like. A combination therapy with at least one therapeutic agent, and the like, may be added, and may bring results of synergism.

The present invention includes diagnostic assay determining expression of C5 protein and/or nucleic acid and C5 protein function in biological samples (for example, blood, blood serum, cells, tissue) or from a subject suffering from complement-related diseases or a subject having a risk thereof. In the antibody of the present invention, for example, radioimmunoassay (REA), enzyme-linked immunosorbent assay (ELISA), and radial diffusion assay are usable for detecting a complement cleavage product. Further, a diagnostic assay, a prognostic assay, pharmacological genetic and clinical monitoring may be used to prophylactically treat a subject with the purpose of prognosis (prediction). In addition, the present invention provides a prognosis (prediction) assay for determining whether or not the subject is at the risk of onset of diseases related with regulation abnormality of activation of complement pathway. For

example, mutation in the C5 gene may be assayed in a biological sample. By using this assay with the purpose of prognosis or prediction, a subject may be prophylactically treated before the onset of diseases characterized by expression or activity of the C5 protein, nucleic acid or diseases related therewith.

In addition, the present invention provides a kit for diagnosing complement-related diseases comprising: a C5-binding molecule; and a container. The kit for diagnosing of the present invention may include at least any one of the above-mentioned C5-binding molecule. The container may include a solid carrier, and the C5-binding molecule may be bound to the solid carrier, and the solid carrier may be porous or non-porous, flat or non-planar.

Further, the present invention provides a use of the C5-binding molecule in preparing a medicament for treating complement-related diseases. The C5-binding molecule of the present invention for preparing a medicament or the composition comprising the same may be mixed with acceptable carriers, and the like, and may be prepared as a complex medication together with other agents to have a synergistic effect of the active ingredients.

In addition, the present invention provides a use of the C5-binding molecule. The C5-binding molecule for treating complement-related diseases of the present invention may be used with the purpose of treatment, and may be used as a use of a prognosis assay for determining expression of the C5 protein and/or nucleic acid or C5 protein function from a subject suffering from complement-related diseases or a subject having a risk thereof.

The descriptions in the use, the composition, and the treatment method of the present invention are applied as the same as each other unless contradictory.

The C5-binding molecule of the present invention is effective for diagnosing, preventing, and treating complement-related diseases.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 shows absorbance of 40 clones randomly selected after bio-panning using immune libraries of rabbit (A) and chicken (B) according to an exemplary embodiment of the present invention.

FIG. 2 shows absorbance measurement results of five kinds of antibodies selected from the immune libraries of rabbit and the immune libraries of chicken according to an exemplary embodiment of the present invention, and eculizumab which is a comparative antibody, to human C5.

FIG. 3 shows results of a number of clones having binding affinity to C5, obtained from five mutant sub-libraries.

FIG. 4 shows comparison results of binding affinity of clones with improved affinity produced by using HRA-06 clone which is humanized clone according to an exemplary embodiment of the present invention as a template.

FIG. 5 shows that the antibody produced according to an exemplary embodiment of the present invention has high complement dependent cytotoxicity inhibitory ability in complement dependent cytotoxicity assay.

FIG. 6 shows the antibody produced according to an exemplary embodiment of the present invention has high C5a generation inhibitory ability in C5a generation assay.

FIG. 7 shows cross-species reactivity of a monoclonal antibody produced according to an exemplary embodiment of the present invention.

FIG. 8 shows results of antibodies produced and purified according to an exemplary embodiment of the present invention by size-exclusion chromatography.

FIG. 9 shows that the antibody according to an exemplary embodiment of the present invention is bound to a beta chain of C5.

FIG. 10 shows that the antibody according to an exemplary embodiment of the present invention is bound to an MG4 domain of the beta chain of C5.

FIG. 11 shows that the antibody according to an exemplary embodiment of the present invention specifically binds to the MG4 domain in a mutant Fc fusion protein in which one domain is sequentially removed from C terminus of the beta chain.

FIG. 12 shows that the antibody according to an exemplary embodiment of the present invention is bound to 332nd to 348th amino acid residues at N-terminus of the beta chain in the mutant from which the MG4 domain is sequentially removed, as confirmed by immunoblotting.

FIG. 13 shows that the antibody according to an exemplary embodiment of the present invention is bound to 379th to 398th amino acid residues at N-terminus of the beta chain, as confirmed by ELISA.

FIG. 14 shows that the antibody according to an exemplary embodiment of the present invention is bound to 386th to 392nd amino acid residues at N-terminus of the beta chain (55th to 61th amino acid sequences based on the MG4 domain sequence), as confirmed by ELISA.

DESCRIPTION OF EMBODIMENTS

Hereinafter, components and technical features of the present invention are described in more detail through the following examples. However, the following Examples are provided by way of examples, and therefore, the protective scope of the present invention is not limited to only the following Examples.

Various examples described herein are described with reference to the drawings. In the following description, various specific details, for example, specific forms, compositions, and preparation methods, and the like, are described for complete understanding of the present invention. However, specific Examples may be practiced without at least one specific details or together with other known methods and forms. In another exemplary embodiment, known processes and manufacturing techniques are not described as specific details so as not to unnecessarily obscure the present invention. Reference of "one exemplary embodiment" or "Examples" throughout the specification means that specific characteristics, forms, compositions, or properties described associated with Examples are included in one or more Examples of the present invention. Therefore, circumstance of expression "one exemplary embodiment" or "Examples" in various places throughout the specification does not necessarily indicate the same exemplary embodiment of the present invention. In addition, the specific characteristics, forms, compositions, or properties may be combined with each other by any suitable method in at least one exemplary embodiment.

Example 1. Construction of C5 Immune Antibody Library

5 µg of human C5 protein (Calbiochem) was mixed with the RIBI MPL+TDM+CWS adjuvant (Sigma, St. Louis, Mo., USA) and injected subcutaneously into NZW rabbits and chickens, and boost immunizations were performed three times in rabbits and four times in chickens with 2-week intervals. Total RNA was isolated from the spleen and bone marrow of the immune-finished rabbit and spleen, bone

marrow and bursa of fabricius of immune-finished chicken, by using TRI reagent (Invitrogen, Carlsbad, Calif., USA), and first-strand cDNA was synthesized using oligo-dT primer and SuperScript™ III First-Strand Synthesis System (Invitrogen). Single-chain Fv libraries were constructed by using primers of Table 9 (rabbit) and Table 10 (chicken) below that are specific to heavy chain variable regions and

light chain variable regions of immunoglobulin. For rabbit scFv library, 10 primer combinations of V_L (9λ V_κ and 1×V_λ)) and 4 combinations of V_H were used to amplify coding sequences. For chicken scFv library, one primer combination of each V_λ and V_H was used to amplify coding sequences.

TABLE 9

Primers for V _κ , V _λ and V _H of rabbit single-chain Fv libraries	
V _κ 5' Sense Primers	
RSCVK1	71. GGG CCC AGG CGG CCG AGC TCG TGM TGA CCC AGA CTC CA
RSCVK2	72. GGG CCC AGG CGG CCG AGC TCG ATM TGA CCC AGA CTC CA
RSCVK3	73. GGG CCC AGG CGG CCG AGC TCG TGA TGA CCC AGA CTG AA
V _κ 3' Reverse Primers, LongLinker	
RKB9J1o-BL	74. GGA AGA TCT AGA GGA ACC ACC CCC ACC ACC GCC CGA GCC ACC GCC ACC AGA GGA TAG GAT CTC CAG CTC GGT CCC
RKB9Jο-BL	75. GGA AGA TCT AGA GGA ACC ACC CCC ACC ACC GCC CGA GCC ACC GCC ACC AGA GGA TAG GAT CTC CAG CTC GGT CCC
RKB42Jο-BL	76. GGA AGA TCT AGA GGA ACC ACC CCC ACC ACC GCC CGA GCC ACC GCC ACC AGA GGA TTT GAC SAC CAC CTC GGT CCC
V _λ 5' Sense Primer	
RSCλJ	77. GGG CCC AGG CGG CCG AGC TCG TGC TGA CTC AGT CGC CCT C
V _λ 3' Reverse Primer, LongLinker	
RJλο-BL	78. GGA AGA TCT AGA GGA ACC ACC CCC ACC ACC GCC CGA GCC ACC GCC ACC AGA GGA GCC TGT GAC GGT CAG CTG GGT CCC
V _H 5' Sense Primers	
RSCVH1	79. GGT GGT TCC TCT AGA TCT TCC CAG TCG GTG GAG GAG TCC RGG
RSCVH2	80. GGT GGT TCC TCT AGA TCT TCC CAG TCG GTG AAG GAG TCC GAG
RSCVH3	81. GGT GGT TCC TCT AGA TCT TCC CAG TCG YTG GAG GAG TCC GGG
RSCVH4	82. GGT GGT TCC TCT AGA TCT TCC CAG SAG CAG CTG RTG GAG TCC GG
V _H 3' Reverse Primers	
RSCG-B	83. CCT GGC CGG CCT GGC CAC TAG TGA CTG AYG GAG CCT TAG GTT GCC C
Overlap Extension Primers	
RSC-F (sense)	84. GAG GAG GAG GAG GAG GAG GCG GGG CCC AGG CGG CCG AGC TC
RSC-B (reverse)	85. GAG GAG GAG GAG GAG GAG CCT GGC CGG CCT GGC CAC TAG TG

TABLE 10

Primers for V _L and V _H of chicken single-chain Fv libraries	
V _L Primers	
CSCVK (sense)	86. GTG GCC CAG GCG GCC CTG ACT CAG CCG TCC TCG GTG TC
CKJo-B (reverse)	87. GGA AGA TCT AGA GGA CTG ACC TAG GAC GGT CAG G
V _H Primers	
CSCVHo-FL (sense)	88. GGT CAG TCC TCT AGA TCT TCC GGC GGT GGT GGC AGC TCC GGT GGT GGC GGT TCC GCC GTG ACG TTG GAC GAG
CSCG-B (reverse)	89. CTG GCC GGC CTG GCC ACT AGT GGA GGA GAC GAT GAC TTC GGT CC
Overlap Extension Primers	
CSC-F (sense)	90. GAG GAG GAG GAG GAG GAG GTG GCC CAG GCG GCC CTG ACT CAG
CSC-B (reverse)	91. GAG GAG GAG GAG GAG GAG GAG CTG GCC GGC CTG GCC ACT AGT GGA GG

In each reaction, 1 µl of cDNA was mixed with 60 pmol of each primer, 10 µl of 10× reaction buffer, 8 µl of 2.5 mM dNTPs, 0.5 µl of Taq DNA polymerase and water to a final volume of 100 µl. The PCR reactions were carried out under the following conditions: 30 cycles of 15 sec at 94° C., 30 sec at 56° C., and 90 sec at 72° C., followed by a final extension for 10 min at 72° C. Amplified fragments with length of approximately 350 base pairs were loaded and run on a 1.5% agarose gel, and purified with QIAEX II Gel Extraction Kit (QIAGEN, Valencia, Calif., USA). In the second round of PCR, the first round V_L products and V_H products were randomly joined by overlap extension PCR. Each PCR reaction was performed in a 100 µl mixture composed of 100 ng of purified V_L product and V_H product, 60 pmol of each primer, 10 µl of 10× reaction buffer, 8 µl of 2.5 mM dNTPs and 0.5 µl of Taq DNA polymerase. The PCR reactions were carried out under the following conditions: 20 cycles of 15 sec at 94° C., 30 sec at 56° C., and 2 min at 72° C., followed by a final extension for 10 min at 72° C. About 700 base pair-sized scFv fragments were purified with QIAEX II Gel Extraction Kit (QIAGEN). The scFv fragments and pComb3XSS vector were digested with SfiI restriction enzyme (Roche Molecular Systems, Pleasanton, Calif., USA) by incubating for 8 hr at 50° C. 700 ng of SfiI-digested scFv was ligated with 1400 ng of pComb3X vector using T4 DNA ligase by incubating the reaction mixture for 12 hr at 16° C., followed by ethanol precipitation. Ligated library was transformed into *E. coli* ER2738 by electoporation. The cells were resuspended with 3 ml of Super Broth (SB) medium and incubated for 1 hr at 37° C. while shaking at 250 rpm. Then 10 ml of SB medium and 3 µl of 100 mg/ml carbenicillin were added to the culture. The library size was determined by plating 0.1, 1 and 10 µl of the culture on Luria Broth (LB) plate containing 50 µg/ml of carbenicillin. After one hour of incubation, 4.5 µl of 100 mg/ml carbenicillin was added to the culture and incubated for an additional hour. The culture was added to 2 ml of VCSM13 helper phage (>10¹¹ cfu/ml), 183 ml of SB medium and 92.5 µl of 100 mg/ml carbenicillin and incubated for 2 hr at 37° C. while shaking at 250 rpm. Kanamycin (280 µl) was added to the culture, and the culture was shaken overnight at 250 rpm and 37° C. The next day, the

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culture was centrifuged at 3,000 g for 15 min. The bacterial pellet was saved for phagemid DNA preparation and the supernatant was transferred to clean centrifuge bottle. 8 g of polyethylene glycol-8000 (PEG-8000, Sigma) and 6 g of NaCl (Merck) were added, and the supernatant was stored on ice for 30 min. The supernatant was centrifuged at 15,000 g for 15 min at 4° C. The phage pellet was resuspended in Tris-buffered saline (TBS) containing 1% bovine serum albumin (BSA).

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Example 2: Bio-Panning

3 ug of human C5 antibody was coated with 1×10⁷ magnetic beads (Dynabeads M270-Epoxy, Invitrogen) at room temperature for 16 hours. The beads were washed with PBS and blocked with PBS containing 3% BSA at room temperature for 1 hour. The coated beads were washed and incubated together with Phage-displayed scFv for 2 hours at room temperature. The beads were washed with 0.5% TPBS to remove phages which were not bound. The bound phages were eluted with 100 ul of 0.1M glycine-HCl and neutralized with 6 ul of 2M Tris-HCl (pH 9.0). The eluted phages infected *E. coli* ER2738 and were rescued with VCSM13 helper phage for overnight amplification. The input and output phage titer were determined by plating the phage infected bacterial culture at 37° C. on LB plate containing 50 µg/ml of carbenicillin. Next day, phage was precipitated by adding PEG-8000 and NaCl as described in Example 1.

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Example 3. Selection of scFv Clones by Phage ELISA

ELISA using phages displaying scFvs was performed against human C5 to analyze the selected clones from bio-panning Microtiter 96-well plate was coated with 100 ng of human C5 per well for overnight at 4° C. and blocked with 3% BSA in PBS. Each phage culture was mixed with an equal volume of 6% BSA in PBS, added to human C5-coated 96-well plate, and incubated for 2 hr at 37° C. After the incubation was finished, the plate was washed and incubated with a HRP conjugated anti-M13 antibody (Amersham, USA). After the incubation was finished, the plate was

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washed, and 1 µg/ml of 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid) (ABTS, Amresco, Ohio, USA) in 0.05 M Citric acid buffer and 1.0% H₂O₂ were added to each well, followed by color formation, and the absorbance was measured at 405 nm.

Results thereof were shown in FIG. 1.

FIG. 1A shows immune libraries of rabbit and FIG. 1B shows immune libraries of chicken. As analysis results of gene sequence of clones exhibiting the absorbance of 0.6 or more to human C5, five scFv clones each having different sequence were obtained from two kinds from rabbit immune libraries and three kinds from chicken immune libraries.

In addition, the selected five kinds of scFv clones and eculizumab which is a control, were converted to ScFv-Fc fusion protein to compare binding affinity by ELISA against C5. Amounts of the antibodies bound to C5 were determined by using HRP-bound anti-human IgG according to the same method as described above, and results thereof were shown in FIG. 2.

As shown in FIG. 2, all of the selected five kinds of scFv clones exhibited higher absorbance than that of eculizumab.

Example 4. Construction of Affinity-Matured and Humanized Antibodies

6 CDRs (complementarity determining regions, light chain antigen complementarity determining regions 1-3 [CDRL 1-3], heavy chain antigen complementarity determining regions 1-3 [CDRH1-3]) having binding affinity and activation inhibiting ability to human complement C5 were inserted between 8 framework regions (FRL1-4, FRH1-4) from the human germline Kappa1/IGHV3-23 to synthesize humanized anti-complement C5 scFv gene (HRA-06, Gen-script, Piscataway, N.J., USA).

To generate mutant sub-libraries of HRA-06, oligonucleotides containing degenerate codons NNK or MNN (N=A, T, G or C, K=G or T, M=A or C) were used. ScFv gene of HRA-06 was used for template DNA. Randomized codons were introduced in five CDRs except CDRH3 by PCR. Amplified scFv fragments were purified with QIAEX II Gel Extraction Kit (QIAGEN). The scFv and pComb3XSS vector were digested with SfiI restriction enzyme (Roche Molecular Systems) and ligated, followed by ethanol precipitation. Ligated libraries were transfected into *E. coli* ER2738 by the same method as Example 1 to construct phage libraries. Antigens were selected based on the constructed phage libraries by the same method as Example 2. Lastly, binding affinity to C5 was confirmed by phage ELISA according to the same method as Example 3.

As shown in FIG. 3, a number of clones having binding affinity to C5 were obtained from 5 kinds of mutant sub-libraries.

Example 5. Construction of Recombinant Anti-C5 Antibodies and Eculizumab as a Control

1. Sub-Cloning of Anti-C5 Antibody into Full IgG Vector and scFv-Fc Vector

Gene encoding human IgG2 hinge and IgG2/4 hybrid CH2-CH3 was inserted into pCEP4 vector (Invitrogen) by HindIII (New England Biolabs) and XhoI (New England Biolabs) restriction enzyme. The gene encoding anti-C5 scFv was sub-cloned in the 5' end of Fc region by two SfiI restriction sites. For the light chain, human immunoglobulin C_κ gene was sub-cloned into a mammalian expression vector. For the heavy chain, the gene from human CH1 and the hinge of human IgG2 to IgG2/4 hybrid CH2-CH3 region

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was sub-cloned into the mammalian expression vector. Variable light chains and variable heavy chains were sub-cloned into this full IgG vector. Antibody sequence of eculizumab was obtained by synthesizing heavy chain and light chain genes based on antibody sequence stated in examination report of Eculizumab (Product Name: Soliris) posted on 'Japan Pharmaceuticals and Medical Devices Agency (PMDA)'.

2. Transfection and Protein Purification

Transfection was performed to over-express recombinant proteins. 2 µg of mammalian expression vector per ml of culture volume and 4 µg of polyethyleneimine/ml (PEI, Polysciences, Warrington, Pa., USA) were mixed in 150 mM NaCl corresponding to 1/10 of culture volume, and let stand at room temperature for 15 min. The mixture was added to the HEK 293F cells (2×10⁶ cells/ml) and incubated for 5 days under the following condition: FreeStyle™ 293 Expression medium containing 100 U/ml penicillin (Invitrogen) and 100 U/ml streptomycin (Invitrogen), 37° C., 7% CO₂, 135 rpm on an orbital shaker. Cell culture supernatants were harvested and subjected to protein A affinity gel chromatography to purify IgG and Fc fusion protein.

Example 6. Measurement of Binding Affinity of Monoclonal Antibody

ELISA (enzyme-linked immunosorbent assay) was performed to measure complement C5 binding affinity of the antibodies produced by Example 5. The antibodies diluted for each concentration were added to 96-well plates coated with C5 to perform reaction. Horseradish peroxidase-labeled anti-human IgG antibody was used as a secondary antibody, followed by color formation with ABTS (2,2'-Azinobis[3-ethylbenzothiazoline-6-sulfonic acid]-diammonium salt), and absorbance was measured by the same method as Example 3.

The monoclonal antibodies used in this experiment were six kinds of affinity-matured and humanized anti-C5 antibodies (HRA-06-H2-1, HRA-06-H2-7, HRA-06-H2-18, HRA-06-H2-24, HRA-06-H1-9-H2-7, HRA-06-H1-9-H2-24) and positive control group antibody Eculizumab, and negative control group antibody Palivizumab, and results thereof were shown in FIG. 3.

As shown in FIG. 4, all of the anti-complement C5 antibodies exhibited binding affinity to C5 and six kinds of affinity-matured and humanized anti-C5 antibodies exhibited high absorbance as compared to Eculizumab.

Example 7: Complement-Dependent Cytotoxicity (CDC) Assay In Vitro

CD20-expressing human Burkitt's lymphoma cell line Ran was kept in RPMI 1640 supplemented with 10% FBS (Invitrogen), 100 U/ml penicillin (Invitrogen) and 100 U/ml streptomycin (Invitrogen). Target cells were washed and resuspended at a concentration of 1×10⁶ cells/ml. Anti-CD20 human IgG, rituximab (Roche) were diluted with CDC solution at a concentration of 3 µg/ml. Equal volume of target cells and sensitizing antibody were mixed together to make a volume of 100 µl/well in 96-well plate, and let stand at room temperature for 5 min. Assay was started by adding human complement serum, resulting in a final volume of 150 µl per well and a final concentration of 4% blood serum. After 2 hours of incubation, 15 µl of Tetrazolium salt (WST-1, Takara Bio, Japan) was added to each well and the plate was incubated for additional 2 hours. The viable cells were analyzed by measuring OD at 450 nm. Effect of anti-C5

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antibody was evaluated by pre-incubation with serum at 37° C. for 30 min prior to adding to target cells and sensitizing antibody mixture. Same concentration of Palivizumab was used as an IgG control. Percentage of cell viability was calculated with the formula:

$$\% \text{ Viability} = \frac{(\text{Test}_{\text{antibody}} - \text{Background})}{(\text{Test}_{\text{without Antibody}} - \text{Background})} \times 100$$

Results thereof were shown in FIG. 5.

As shown in FIG. 5, the affinity-matured and humanized anti-C5 antibodies produced according to the present invention exhibited CDC inhibitory ability, and all of the antibodies exhibited high cell viability as compared to Eculizumab.

Example 8: Measurement of C5a Production Content In Vitro

After 2 hours of incubation of target cells, sensitizing antibody and serum, the cells were pelleted by centrifugation and the supernatant was assayed for C5a content by sandwich ELISA using the BD OptiEIA™ Human C5a ELISA Kit II (BD Biosciences, San Jose, Calif., USA) following manufacturer's instruction.

Results thereof were shown in FIG. 6.

As shown in FIG. 6, all of the affinity-matured and humanized anti-C5 antibodies produced according to the present invention exhibited C5a production inhibitory ability, and all of four kinds of affinity-matured and humanized anti-C5 antibodies exhibited high inhibitory ability as compared to Eculizumab.

Example 9: Measurement of Cross-Species Reactivity of Monoclonal Antibody

Immunoblotting was performed to confirm whether or not the monoclonal antibody was bound to the complement C5 of other species rather than human. Blood serums of human C5 protein and human (Sigma), rhesus monkey, BALB/c mouse, Wistar rat, NZW rabbit were diluted and subjected to SDS-PAGE, respectively, and resolved proteins were transferred to nitrocellulose membrane. Immunoblotting was performed by the anti-complement C5 antibody HRA-06-H2-1 produced according to the present invention.

Results thereof were shown in FIG. 7.

As shown in FIG. 7, the anti-complement C5 antibodies exhibited binding affinity to C5 of human (Sigma), rhesus monkey, Wistar rat, and NZW rabbit.

Example 10: Size-Exclusion Chromatography

Size-exclusion chromatography (SEC) analysis was performed on purified antibodies by using Waters 2489 system (Waters Corporation, Milford, Mass., USA), and Zenix-C 300 column (Sepax Technologies, Inc., Newark, Del., USA). Mobile phase composition (150 mM sodium phosphate, pH 7.0) and flow rate (1.0 mL/min) were constant in all runs. Concentration of protein was determined by monitoring the absorbance of column eluate at 280 nm. Fractional concentration was calculated by dividing individual peak areas by the sum of peak areas.

Results thereof were shown in FIG. 8. FIGS. 8A to 8D represent A) HRA-06-H2-1, B) HRA-06-H2-7, C) HRA-06-H2-18, D) HRA-06-H2-24, E) HRA-06-H1-9-H2-7 and F) HRA-06-H1-9-H2-24, respectively.

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As shown in FIG. 8, it was confirmed that aggregation was hardly detected in physical chemical properties of the anti-complement C5 antibody.

Example 11: Epitope Mapping

1. Confirmation of Binding of Antibody to C5 Beta-Chain

Complement C5 proteins were subjected to SDS-PAGE under non-reducing condition (lane 1) and reducing condition (lane 2), respectively, followed by immunoblotting using the anti-complement C5 antibody, to confirm whether or not beta-chain binding was formed. Results thereof were shown in FIG. 9.

FIG. 9A shows the binding when Eculizumab was used as an antibody, and FIG. 9B shows the binding when HRA-06-H2-1 according to the present invention was used as an antibody. As known in the art, it was confirmed that Eculizumab was bound to C5 (entire complement protein), and bound to alpha-chain in lane 2 under reducing condition. Meanwhile, it was confirmed that HRA-06-H2-1 antibody according to the present invention bound to C5 (entire complement protein), and bound to beta-chain in lane 2 under reducing condition.

2. Production of C5 Beta Chain Mutant Domains as Fc Fusion Proteins and Identification of Binding Site

Six domains consisting beta chain of C5 and serial deletion mutant of beta chain were amplified from cDNA. The primers were designed to add SfiI restriction sites at both the 5' and 3' ends (Table 11). The serial deletion mutant of beta chain of C5 was amplified by primer combination as described in Table 12. The amplified PCR fragments were digested with SfiI and cloned into modified pCEP4 vector containing the hinge region and CH2-CH3 domain of human IgG1 at the 3' region of the cloning site. These clones were transfected and Fc fusion proteins were purified as described in Example 5.

TABLE 11

Primer sequences for amplification of beta chain domains

Forward primers (5'→3')

MG1_F 92. GGCCAGGCGGCCATGGGCCTTTTGGGAATACTTTG
MG2_F 93. GGCCAGGCGGCCAATGGATTCTCTTCATTTCATAC
MG3_F 94. GGCCAGGCGGCCCCACATTTTCTGTCTCAATC
MG4_F 95. GGCCAGGCGGCCTCTCCCTACAACTGAATTTG
MG5_F 96. GGCCAGGCGGCCACTGATAACCATAAGGCTTTG
Linker_F 97. GGCCAGGCGGCCTCCTGGGTGGCATTAGC

Reverse primers (5'→3')

MG1_R 98. GGCCGGCCTGGCCGTCATAGGTTATTGGCATTCT
MG2_R 99. GGCCGGCCTGGCCCAAGACATATTCTTTAACTTC
MG3_R 100. GGCCGGCCTGGCCGAGGACATATTGTATGCCAG
MG4_R 101. GGCCGGCCTGGCCCAATCAATATAAAGGTAACCTTG
MG5_R 102. GGCCGGCCTGGCCATCCATTCCAGTTGCCATATTA
Linker_R 103. GGCCGGCCTGGCCGAGAATTTCTTTACAAGGTTTC

TABLE 12

Primer combinations for construction of beta chain domains and deletion mutant of beta chain	
Domain name	Primer combination
MG1	MG1_F/MG1-R
MG2	MG2_F/MG2-R
MG3	MG3_F/MG3-R
MG4	MG4_F/MG4-R
MG5	MG5_F/MG5-R
Linker	Linker_F/Linker-R
MG1-2	MG1_F/MG2-R
MG1-3	MG1_F/MG3-R
MG1-4	MG1_F/MG4-R
MG1-5	MG1_F/MG5-R

The proteins comprising each domain were subjected to SDS-PAGE, respectively, and immunoblotting was performed by using anti-complement C5 antibody (HRA-06-H2-1). Results thereof were shown in FIGS. 10 and 11.

FIG. 10A is schematic diagram showing a structure of the C5 beta chain, and the produced Fc fusion protein, and FIG. 10B shows immunoblotting results. As shown in FIG. 10, it was confirmed that the HRA-06-H2-1 antibody produced according to the present invention bound to the Fc fusion protein having an MG4 domain.

FIG. 11A is schematic diagram showing a structure of the C5 beta chain, and the produced Fc fusion protein, and FIG. 11B shows immunoblotting results. As shown in FIG. 11, it was confirmed that the HRA-06-H2-1 antibody produced according to the present invention was bound only to the Fc fusion protein comprising an MG4 domain.

3. Production of MG4 Domains as Fc Fusion Proteins and Identification of Binding Site

MG4 domain of the beta chain and five mutants from which the MG4 domain is sequentially removed from N-terminus of the MG4 domain were cloned. The primers were designed to add SfiI restriction sites at both the 5' and 3' ends (Table 13). The amplified PCR fragments were digested with SfiI and cloned into modified pCEP4 vector containing the hinge region and CH2-CH3 domain of human IgG1 at the 3' region of the cloning site. These clones were transfected and Fc fusion proteins were purified as described in Example 5. The purified Fc fusion proteins were subjected to SDS-PAGE, and immunoblotting was performed as described above.

TABLE 13

Primer sequences for amplification of MG4 domains	
Forward primers (5'→3')	
hMG4_F	104. GGCCCAGGCGGCCTCTCCCTACAACTGAATTTG
d332-348_F	105. GGCCCAGGCGGCCATTCCATATCCCATCAAGG
d332-378_F	106. GGCCCAGGCGGCCGTAAACCAAGAGACATCTGAC
d332-396_F	107. GGCCCAGGCGGCCGATGGAGTAGCTTCCTTTG
d332-424_F	108. GGCCCAGGCGGCCCCAGAAGAAATCAGGCC
Reverse primers (5'→3')	
hMG4_R	109. GGCCGGCCTGGCCCCAATCAATATAAAGGTAACTTTG

Results thereof were shown in FIG. 12. FIG. 12A shows MG4 domain and Fc fusion protein produced by sequentially removing the domain, and FIG. 12B shows results of

immunoblotting, using HRA-06-H2-1 antibody. As shown in FIG. 12, it was confirmed that the binding was not achieved in the mutants from which 332nd-348th amino acid residue sequences were removed from N-terminus of the beta chain, which could be appreciated that 332nd-348th amino acid residue sequences in the MG4 domain of the beta chain were sequences having high antibody-binding possibility.

4. Confirmation of Antibody-Binding Sites from Human/Mouse Hybrid MG4 Domains

Human/mouse hybrid MG4 domains of the C5 beta chain were produced in overlap extension PCR. The primers were designed to add SfiI restriction sites at both the 5' and 3' ends (Table 14). PCR fragments were digested with SfiI and cloned into Sfi I-digested pComb3X vector. These clones were transfected into *E. coli* ER 2738. Single colony from each human/mouse MG4 hybrid was incubated until absorbance at 600 nm reached about 1.0. Phage infection was performed by adding VCSM13 helper phage (10¹¹ pfu/ml), followed by incubation at 37° C. for 2 hr. Kanamycin (25 µg/ml) was added and the culture was incubated at 37° C. overnight with constant shaking. Bacteria were removed by centrifugation at 3,000 g for 15 min

TABLE 14

Primer sequences for amplification of human/mouse hybrid MG4 domains	
hMG4-m332-348 Structure	
m332-348_F	110. GGCCCAGGCGGCCTCTCCCTACACACTGAATTTGGTC GCTACTCCTCTTTTCGTGAAGCCCGGATTCCATATCC CATCAAGGTGC
hMG4_R	111. GGCCCAGGCGGCCTCTCCCTACAACTGAATTTG
Amplification of N-terminus of Mouse MG4 Forward primers (5'→3')	
mMG4_F	112. TCTCCCTACACACTGAATTTGG
Reverse primers (5'→3')	
m332-359_R	113. GTCAAGCGAATCTTTAACCTGTGCCTTG
m332-368_R	114. TGTTACTGGGACCCCTCCTACCGCCTG
m332-378_R	115. TTGGTTTACATCGACTGTTTGTGCCATC
m332-385_R	116. TGGATCCAAGTCAGATGTCTCTTGATTAC
m332-392_R	117. AACACGTGTGATGCTCCTCTTTGTTTCC
m332-398_R	118. GGAAGCTACTCCATCAGTGTGTCATGAGTG
m332-409_R	119. CACCGTCACATTTGATGGGAGGTTTCAGC
Amplification of C-terminus of Human MG4 Forward primers (5'→3')	
m332-359_F	120. GTTAAAGATTTCGCTTGACCAGTTGGTAG
m332-368_F	121. GGAGGGGTCCCAGTAACACTGAATGCAC
m332-378_F	122. ACAGTCGATGTAAACCAAGAGACATCTGAC
m332-385_F	123. ACATCTGACTTGGATCCAAGCAAAAGTGT
m332-392_F	124. AGGAGCATCACACGTGTTGATGATGGAGTA
m332-398_F	125. ACTGATGGAGTAGCTTCCTTTGTGCTTAATC

TABLE 14-continued

Primer sequences for amplification of human/mouse hybrid MG4 domains		
m332-409_F	126.	CCATCAAATGTGACGGTGCTGGAGTTTA
Reverse primers (5'→3')		
hMG4_R	127.	GGCCCAGGCGGCCTCTCCCTACAAACTGAATTTG
mMG4-h332-348 ² Structure		
h332-348_F	128.	GGCCCAGGCGGCCTCTCCCTACAAACTGAATTT GGTTGCTACTCCTCTTTTCCTGAAGCCTGGGATTCCA TTTTCCATCAAG
mMG4_R	129.	CCAAGCGATGTAAATGTAAC
Amplification of N-terminus of Human MG4 Forward primers (5'→3')		
hMG4_F	130.	GGCCCAGGCGGCCTCTCCCTACAAACTGAATTTG
Reverse primers (5'→3')		
h332-359_R	131.	CTCGAGTGAATCTTTAACCTGCACCTTGA
h332-368_R	132.	AGTTACTGGGACTCCTCCTACCAACTG
h332-378_R	133.	TTGATTCACATCAATTGTTTGTGCATTGAG
h332-385_R	134.	TGTTTCCAAGTCAGATGTCTCTTGGTTTAC
h332-392_R	135.	GTCATGAGTTACACTTTTGCTTGGATCCA
h332-398_R	136.	CACAGCTACTCCATCATCAACACGTGTTAC
h332-409_R	137.	CACCGTCACTCCAGATGGGAGATTAAGCAC
Amplification of C-terminus of Mouse MG4 Forward primers (5'→3')		
h332-359_F	138.	GTAAAGATTCACTCGAGCAGGCGGT
h332-368_F	139.	GGAGGAGTCCCAGTAACTCTGATGGCAC
h332-378_F	140.	ACAATTGATGTGAATCAAGAGACATCTGAC
h332-385_F	141.	ACATCTGACTTGGAACAAAGAGGAGCATC

TABLE 14-continued

Primer sequences for amplification of human/mouse hybrid MG4 domains		
h332-392_F	142.	CAAAAGTGTAACATGACACTGATGGAG
h332-398_F	143.	GATGATGGAGTAGCTGTGTTTGTGCTGAAC
h332-409_F	144.	CCATCTGGAGTGACGGTGCTAAAGTTTG
Reverse primers (5'→3')		
mMG4_R	145.	CCAAGCGATGTAAATGTAAC

5
10
15
20
25
30
35
40

Phage ELISA was performed as follows. Anti-C5 IgG2/4, HRA-06-H2-7, was diluted in 0.1 M sodium bicarbonate buffer (pH 8.6) and 100 ng of the antibody was coated on 96 well plate at 4° C. overnight. Each well was blocked by adding 100 μl of 5% skim milk in TBS containing 0.05% Tween 20 and incubated for 1 hr at 37° C. Phage was diluted two fold in 6% BSA/PBS then 50 μl of diluted phage was added to each well, and incubated for 2 hr at 37° C. The plate was washed, and 50 μl of diluted HRP-bound anti-M13 antibody (1:5000) was added, and the plate was incubated for 1 hr at 37° C. The plate was washed, and 50 μl of ABTS substrate solution was added to each well and the absorbance was measured at 405 nm.

Results thereof were shown in FIGS. 13 and 14.

FIG. 13A shows human/mouse hybrid MG4 domains, and FIG. 13B shows ELISA results. As shown in FIG. 13, the HRA-06-H2-7 antibody was bound when 379th to 398th amino acid residue sequences based on the beta chain sequence were human sequences, which shows binding possibility to the corresponding site of the antibody.

FIG. 14 shows results obtained by more specifically confirming the binding sites of the sequences. FIG. 14A shows human/mouse hybrid MG4 domains, and FIG. 14B shows ELISA results. As shown in FIG. 14, the HRA-06-H2-7 antibody was bound when 386th to 392nd amino acid residue sequences based on the beta chain sequence (55th to 61th amino acid sequences based on the MG4 domain sequence) were human sequences, which shows binding possibility to the corresponding site of the antibody.

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Val Ala Ser Val Trp Pro Gly Ile Thr Gly Asp Thr Asn Tyr Ala Asn
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Trp Ala Lys Gly Arg Phe Thr Ile Ser Arg Asp Asp Ser Lys Asn Thr
65 70 75 80
Leu Tyr Leu Gln Met Asn Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr
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		20						25					30		
Leu	Ser	Trp	Tyr	Gln	Gln	Lys	Pro	Gly	Lys	Ala	Pro	Lys	Leu	Leu	Ile
		35					40					45			
Tyr	Tyr	Ala	Ser	Thr	Leu	Ala	Ser	Gly	Val	Pro	Ser	Arg	Phe	Ser	Gly
	50					55				60					
Ser	Gly	Ser	Gly	Thr	Asp	Phe	Thr	Leu	Thr	Ile	Ser	Ser	Leu	Gln	Pro
	65				70					75					80
Glu	Asp	Phe	Ala	Thr	Tyr	Tyr	Cys	Gln	Gly	Ser	Tyr	Tyr	Ser	Gly	Gly
				85					90					95	
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		20						25					30		
Tyr	Trp	Ile	Gln	Trp	Val	Arg	Gln	Ala	Pro	Gly	Lys	Gly	Leu	Glu	Trp
		35					40					45			
Val	Ala	Ser	Val	Trp	Pro	Gly	Ile	Thr	Gly	Asp	Thr	Asn	Tyr	Ala	Asn
	50					55				60					
Trp	Ala	Lys	Gly	Arg	Phe	Thr	Ile	Ser	Arg	Asp	Asp	Ser	Lys	Asn	Thr
	65				70					75					80
Leu	Tyr	Leu	Gln	Met	Asn	Ser	Leu	Arg	Ala	Glu	Asp	Thr	Ala	Val	Tyr
			85					90					95		
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Cys	Val	Glu	Cys	Pro	Pro	Cys	Pro	Ala	Pro	Pro	Val	Ala	Gly	Pro	Ser
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Val	Phe	Leu	Phe	Pro	Pro	Lys	Pro	Lys	Asp	Thr	Leu	Met	Ile	Ser	Arg	
				245					250					255		
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			260					265					270			
Glu	Val	Gln	Phe	Asn	Trp	Tyr	Val	Asp	Gly	Val	Glu	Val	His	Asn	Ala	
		275					280					285				
Lys	Thr	Lys	Pro	Arg	Glu	Glu	Gln	Phe	Asn	Ser	Thr	Tyr	Arg	Val	Val	
	290					295					300					
Ser	Val	Leu	Thr	Val	Leu	His	Gln	Asp	Trp	Leu	Asn	Gly	Lys	Glu	Tyr	
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Lys	Cys	Lys	Val	Ser	Asn	Lys	Gly	Leu	Pro	Ser	Ser	Ile	Glu	Lys	Thr	
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			340					345					350			
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		355					360					365				
Leu	Val	Lys	Gly	Phe	Tyr	Pro	Ser	Asp	Ile	Ala	Val	Glu	Trp	Glu	Ser	
	370					375					380					
Asn	Gly	Gln	Pro	Glu	Asn	Asn	Tyr	Lys	Thr	Thr	Pro	Pro	Val	Leu	Asp	
385					390					395					400	
Ser	Asp	Gly	Ser	Phe	Phe	Leu	Tyr	Ser	Arg	Leu	Thr	Val	Asp	Lys	Ser	
				405					410					415		
Arg	Trp	Gln	Glu	Gly	Asn	Val	Phe	Ser	Cys	Ser	Val	Met	His	Glu	Ala	
		420						425					430			
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Leu	Ser	Trp	Tyr	Gln	Gln	Lys	Pro	Gly	Lys	Ala	Pro	Lys	Leu	Leu	Ile	
		35					40					45				
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Ser	Gly	Ser	Gly	Thr	Asp	Phe	Thr	Leu	Thr	Ile	Ser	Ser	Leu	Gln	Pro	
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Glu	Asp	Phe	Ala	Thr	Tyr	Tyr	Cys	Gln	Gly	Ser	Tyr	Tyr	Ser	Gly	Gly	
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Trp	Asp	Tyr	Gly	Phe	Gly	Gln	Gly	Thr	Lys	Val	Glu	Ile	Lys	Arg	Thr	
		100						105					110			
Val	Ala	Ala	Pro	Ser	Val	Phe	Ile	Phe	Pro	Pro	Ser	Asp	Glu	Gln	Leu	
		115					120					125				
Lys	Ser	Gly	Thr	Ala	Ser	Val	Val	Cys	Leu	Leu	Asn	Asn	Phe	Tyr	Pro	
	130					135					140					
Arg	Glu	Ala	Lys	Val	Gln	Trp	Lys	Val	Asp	Asn	Ala	Leu	Gln	Ser	Gly	
145					150				155					160		
Asn	Ser	Gln	Glu	Ser	Val	Thr	Glu	Gln	Asp	Ser	Lys	Asp	Ser	Thr	Tyr	


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Ser Leu Ser Ser Thr Leu Thr Leu Ser Lys Ala Asp Tyr Glu Lys His
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Thr Lys Ser Phe Asn Arg Gly Glu Cys
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Lys Gly

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35 40 45

Val Ala Ser Gly Trp Pro Gly Ala Thr Gly Asp Thr Asn Tyr Ala Asn
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Trp Ala Lys Gly Arg Phe Thr Ile Ser Arg Asp Asp Ser Lys Asn Thr
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Leu Tyr Leu Gln Met Asn Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr
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Leu Ser Trp Tyr Gln Gln Lys Pro Gly Lys Ala Pro Lys Leu Leu Ile
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Tyr Tyr Ala Ser Thr Leu Ala Ser Gly Val Pro Ser Arg Phe Ser Gly
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Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr Ile Ser Ser Leu Gln Pro
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Ser	Asp	Gly	Ser	Phe	Phe	Leu	Tyr	Ser	Arg	Leu	Thr	Val	Asp	Lys	Ser
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Arg	Trp	Gln	Glu	Gly	Asn	Val	Phe	Ser	Cys	Ser	Val	Met	His	Glu	Ala
		420						425					430		
Leu	His	Asn	His	Tyr	Thr	Gln	Lys	Ser	Leu	Ser	Leu	Ser	Leu	Gly	Lys
		435					440					445			

<210> SEQ ID NO 20
<211> LENGTH: 217
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

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<400> SEQUENCE: 20

Asp Ile Gln Met Thr Gln Ser Pro Ser Ser Leu Ser Ala Ser Val Gly
1 5 10 15

Asp Arg Val Thr Ile Thr Cys Gln Ala Ser Gln Ser Ile Asn Asn Gln
20 25 30

Leu Ser Trp Tyr Gln Gln Lys Pro Gly Lys Ala Pro Lys Leu Leu Ile
35 40 45

Tyr Tyr Ala Ser Thr Leu Ala Ser Gly Val Pro Ser Arg Phe Ser Gly
50 55 60

Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr Ile Ser Ser Leu Gln Pro
65 70 75 80

Glu Asp Phe Ala Thr Tyr Tyr Cys Gln Gly Ser Tyr Tyr Ser Gly Gly
85 90 95

Trp Asp Tyr Gly Phe Gly Gln Gly Thr Lys Val Glu Ile Lys Arg Thr
100 105 110

Val Ala Ala Pro Ser Val Phe Ile Phe Pro Pro Ser Asp Glu Gln Leu
115 120 125

Lys Ser Gly Thr Ala Ser Val Val Cys Leu Leu Asn Asn Phe Tyr Pro
130 135 140

Arg Glu Ala Lys Val Gln Trp Lys Val Asp Asn Ala Leu Gln Ser Gly
145 150 155 160

Asn Ser Gln Glu Ser Val Thr Glu Gln Asp Ser Lys Asp Ser Thr Tyr
165 170 175

Ser Leu Ser Ser Thr Leu Thr Leu Ser Lys Ala Asp Tyr Glu Lys His
180 185 190

Lys Val Tyr Ala Cys Glu Val Thr His Gln Gly Leu Ser Ser Pro Val
195 200 205

Thr Lys Ser Phe Asn Arg Gly Glu Cys
210 215

<210> SEQ ID NO 21
<211> LENGTH: 11
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 21

Gly Phe Ser Phe Ser Gly Arg Tyr Trp Ile Gln
1 5 10

<210> SEQ ID NO 22
<211> LENGTH: 18
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 22

Ser Ser Ser Leu Arg Gly Thr Gly Asp Thr Asn Tyr Ala Asn Trp Ala
1 5 10 15

Lys Gly

<210> SEQ ID NO 23
<211> LENGTH: 11
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 23

Glu Pro Val Ala Trp Gly Gly Gly Leu Asp Leu
1 5 10

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<210> SEQ ID NO 24
<211> LENGTH: 11
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 24

Gln Ala Ser Gln Ser Ile Asn Asn Gln Leu Ser
1 5 10

<210> SEQ ID NO 25
<211> LENGTH: 7
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 25

Tyr Ala Ser Thr Leu Ala Ser
1 5

<210> SEQ ID NO 26
<211> LENGTH: 12
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 26

Gln Gly Ser Tyr Tyr Ser Gly Gly Trp Asp Tyr Gly
1 5 10

<210> SEQ ID NO 27
<211> LENGTH: 122
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 27

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Gln Pro Gly Gly
1 5 10 15

Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Ser Phe Ser Gly Arg
20 25 30

Tyr Trp Ile Gln Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp
35 40 45

Val Ala Ser Ser Ser Leu Arg Gly Thr Gly Asp Thr Asn Tyr Ala Asn
50 55 60

Trp Ala Lys Gly Arg Phe Thr Ile Ser Arg Asp Asp Ser Lys Asn Thr
65 70 75 80

Leu Tyr Leu Gln Met Asn Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr
85 90 95

Tyr Cys Ala Arg Glu Pro Val Ala Trp Gly Gly Gly Leu Asp Leu Trp
100 105 110

Gly Gln Gly Thr Leu Val Thr Val Ser Ser
115 120

<210> SEQ ID NO 28
<211> LENGTH: 110
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 28

Asp Ile Gln Met Thr Gln Ser Pro Ser Ser Leu Ser Ala Ser Val Gly
1 5 10 15

Asp Arg Val Thr Ile Thr Cys Gln Ala Ser Gln Ser Ile Asn Asn Gln
20 25 30

-continued

Leu	Ser	Trp	Tyr	Gln	Gln	Lys	Pro	Gly	Lys	Ala	Pro	Lys	Leu	Leu	Ile
	35						40					45			
Tyr	Tyr	Ala	Ser	Thr	Leu	Ala	Ser	Gly	Val	Pro	Ser	Arg	Phe	Ser	Gly
	50					55				60					
Ser	Gly	Ser	Gly	Thr	Asp	Phe	Thr	Leu	Thr	Ile	Ser	Ser	Leu	Gln	Pro
	65				70					75					80
Glu	Asp	Phe	Ala	Thr	Tyr	Tyr	Cys	Gln	Gly	Ser	Tyr	Tyr	Ser	Gly	Gly
				85					90					95	
Trp	Asp	Tyr	Gly	Phe	Gly	Gln	Gly	Thr	Lys	Val	Glu	Ile	Lys		
			100					105					110		
<210> SEQ ID NO 29															
<211> LENGTH: 448															
<212> TYPE: PRT															
<213> ORGANISM: Homo sapiens															
<400> SEQUENCE: 29															
Glu	Val	Gln	Leu	Val	Glu	Ser	Gly	Gly	Gly	Leu	Val	Gln	Pro	Gly	Gly
	1			5					10					15	
Ser	Leu	Arg	Leu	Ser	Cys	Ala	Ala	Ser	Gly	Phe	Ser	Phe	Ser	Gly	Arg
			20					25					30		
Tyr	Trp	Ile	Gln	Trp	Val	Arg	Gln	Ala	Pro	Gly	Lys	Gly	Leu	Glu	Trp
		35					40					45			
Val	Ala	Ser	Ser	Ser	Leu	Arg	Gly	Thr	Gly	Asp	Thr	Asn	Tyr	Ala	Asn
	50					55					60				
Trp	Ala	Lys	Gly	Arg	Phe	Thr	Ile	Ser	Arg	Asp	Asp	Ser	Lys	Asn	Thr
	65				70					75					80
Leu	Tyr	Leu	Gln	Met	Asn	Ser	Leu	Arg	Ala	Glu	Asp	Thr	Ala	Val	Tyr
			85					90						95	
Tyr	Cys	Ala	Arg	Glu	Pro	Val	Ala	Trp	Gly	Gly	Gly	Leu	Asp	Leu	Trp
		100						105					110		
Gly	Gln	Gly	Thr	Leu	Val	Thr	Val	Ser	Ser	Ala	Ser	Thr	Lys	Gly	Pro
		115					120					125			
Ser	Val	Phe	Pro	Leu	Ala	Pro	Cys	Ser	Arg	Ser	Thr	Ser	Glu	Ser	Thr
	130					135					140				
Ala	Ala	Leu	Gly	Cys	Leu	Val	Lys	Asp	Tyr	Phe	Pro	Glu	Pro	Val	Thr
	145				150					155					160
Val	Ser	Trp	Asn	Ser	Gly	Ala	Leu	Thr	Ser	Gly	Val	His	Thr	Phe	Pro
			165						170					175	
Ala	Val	Leu	Gln	Ser	Ser	Gly	Leu	Tyr	Ser	Leu	Ser	Ser	Val	Val	Thr
		180						185					190		
Val	Pro	Ser	Ser	Asn	Phe	Gly	Thr	Gln	Thr	Tyr	Thr	Cys	Asn	Val	Asp
	195						200					205			
His	Lys	Pro	Ser	Asn	Thr	Lys	Val	Asp	Lys	Thr	Val	Glu	Arg	Lys	Cys
	210					215					220				
Cys	Val	Glu	Cys	Pro	Pro	Cys	Pro	Ala	Pro	Pro	Val	Ala	Gly	Pro	Ser
	225				230					235					240
Val	Phe	Leu	Phe	Pro	Pro	Lys	Pro	Lys	Asp	Thr	Leu	Met	Ile	Ser	Arg
			245						250					255	
Thr	Pro	Glu	Val	Thr	Cys	Val	Val	Val	Asp	Val	Ser	Gln	Glu	Asp	Pro
		260						265					270		
Glu	Val	Gln	Phe	Asn	Trp	Tyr	Val	Asp	Gly	Val	Glu	Val	His	Asn	Ala
	275						280					285			
Lys	Thr	Lys	Pro	Arg	Glu	Glu	Gln	Phe	Asn	Ser	Thr	Tyr	Arg	Val	Val

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290					295					300					
Ser	Val	Leu	Thr	Val	Leu	His	Gln	Asp	Trp	Leu	Asn	Gly	Lys	Glu	Tyr
305					310					315					320
Lys	Cys	Lys	Val	Ser	Asn	Lys	Gly	Leu	Pro	Ser	Ser	Ile	Glu	Lys	Thr
				325					330					335	
Ile	Ser	Lys	Ala	Lys	Gly	Gln	Pro	Arg	Glu	Pro	Gln	Val	Tyr	Thr	Leu
			340					345					350		
Pro	Pro	Ser	Gln	Glu	Glu	Met	Thr	Lys	Asn	Gln	Val	Ser	Leu	Thr	Cys
		355					360					365			
Leu	Val	Lys	Gly	Phe	Tyr	Pro	Ser	Asp	Ile	Ala	Val	Glu	Trp	Glu	Ser
	370					375					380				
Asn	Gly	Gln	Pro	Glu	Asn	Asn	Tyr	Lys	Thr	Thr	Pro	Pro	Val	Leu	Asp
385					390					395					400
Ser	Asp	Gly	Ser	Phe	Phe	Leu	Tyr	Ser	Arg	Leu	Thr	Val	Asp	Lys	Ser
				405					410					415	
Arg	Trp	Gln	Glu	Gly	Asn	Val	Phe	Ser	Cys	Ser	Val	Met	His	Glu	Ala
			420					425					430		
Leu	His	Asn	His	Tyr	Thr	Gln	Lys	Ser	Leu	Ser	Leu	Ser	Leu	Gly	Lys
		435					440					445			
<210> SEQ ID NO 30															
<211> LENGTH: 217															
<212> TYPE: PRT															
<213> ORGANISM: Homo sapiens															
<400> SEQUENCE: 30															
Asp	Ile	Gln	Met	Thr	Gln	Ser	Pro	Ser	Ser	Leu	Ser	Ala	Ser	Val	Gly
1				5					10					15	
Asp	Arg	Val	Thr	Ile	Thr	Cys	Gln	Ala	Ser	Gln	Ser	Ile	Asn	Asn	Gln
			20					25					30		
Leu	Ser	Trp	Tyr	Gln	Gln	Lys	Pro	Gly	Lys	Ala	Pro	Lys	Leu	Leu	Ile
		35				40						45			
Tyr	Tyr	Ala	Ser	Thr	Leu	Ala	Ser	Gly	Val	Pro	Ser	Arg	Phe	Ser	Gly
	50					55				60					
Ser	Gly	Ser	Gly	Thr	Asp	Phe	Thr	Leu	Thr	Ile	Ser	Ser	Leu	Gln	Pro
65					70					75					80
Glu	Asp	Phe	Ala	Thr	Tyr	Tyr	Cys	Gln	Gly	Ser	Tyr	Tyr	Ser	Gly	Gly
				85					90					95	
Trp	Asp	Tyr	Gly	Phe	Gly	Gln	Gly	Thr	Lys	Val	Glu	Ile	Lys	Arg	Thr
			100					105					110		
Val	Ala	Ala	Pro	Ser	Val	Phe	Ile	Phe	Pro	Pro	Ser	Asp	Glu	Gln	Leu
		115					120					125			
Lys	Ser	Gly	Thr	Ala	Ser	Val	Val	Cys	Leu	Leu	Asn	Asn	Phe	Tyr	Pro
	130					135					140				
Arg	Glu	Ala	Lys	Val	Gln	Trp	Lys	Val	Asp	Asn	Ala	Leu	Gln	Ser	Gly
145					150				155						160
Asn	Ser	Gln	Glu	Ser	Val	Thr	Glu	Gln	Asp	Ser	Lys	Asp	Ser	Thr	Tyr
			165						170					175	
Ser	Leu	Ser	Ser	Thr	Leu	Thr	Leu	Ser	Lys	Ala	Asp	Tyr	Glu	Lys	His
			180					185					190		
Lys	Val	Tyr	Ala	Cys	Glu	Val	Thr	His	Gln	Gly	Leu	Ser	Ser	Pro	Val
		195					200					205			
Thr	Lys	Ser	Phe	Asn	Arg	Gly	Glu	Cys							
	210					215									

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<210> SEQ ID NO 31
<211> LENGTH: 11
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 31

Gly Phe Ser Phe Ser Gly Arg Tyr Trp Ile Gln
1 5 10

<210> SEQ ID NO 32
<211> LENGTH: 18
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 32

Ser Val Trp Pro Gly Phe Thr Gly Asp Thr Asn Tyr Ala Asn Trp Ala
1 5 10 15

Lys Gly

<210> SEQ ID NO 33
<211> LENGTH: 11
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 33

Glu Pro Val Ala Trp Gly Gly Gly Leu Asp Leu
1 5 10

<210> SEQ ID NO 34
<211> LENGTH: 11
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 34

Gln Ala Ser Gln Ser Ile Asn Asn Gln Leu Ser
1 5 10

<210> SEQ ID NO 35
<211> LENGTH: 7
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 35

Tyr Ala Ser Thr Leu Ala Ser
1 5

<210> SEQ ID NO 36
<211> LENGTH: 12
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 36

Gln Gly Ser Tyr Tyr Ser Gly Gly Trp Asp Tyr Gly
1 5 10

<210> SEQ ID NO 37
<211> LENGTH: 122
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 37

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Gln Pro Gly Gly
1 5 10 15

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Ser	Leu	Arg	Leu	Ser	Cys	Ala	Ala	Ser	Gly	Phe	Ser	Phe	Ser	Gly	Arg
			20					25					30		
Tyr	Trp	Ile	Gln	Trp	Val	Arg	Gln	Ala	Pro	Gly	Lys	Gly	Leu	Glu	Trp
		35					40					45			
Val	Ala	Ser	Val	Trp	Pro	Gly	Phe	Thr	Gly	Asp	Thr	Asn	Tyr	Ala	Asn
	50					55				60					
Trp	Ala	Lys	Gly	Arg	Phe	Thr	Ile	Ser	Arg	Asp	Asp	Ser	Lys	Asn	Thr
	65				70					75					80
Leu	Tyr	Leu	Gln	Met	Asn	Ser	Leu	Arg	Ala	Glu	Asp	Thr	Ala	Val	Tyr
				85					90					95	
Tyr	Cys	Ala	Arg	Glu	Pro	Val	Ala	Trp	Gly	Gly	Gly	Leu	Asp	Leu	Trp
			100					105					110		
Gly	Gln	Gly	Thr	Leu	Val	Thr	Val	Ser	Ser						
		115					120								
<210> SEQ ID NO 38															
<211> LENGTH: 110															
<212> TYPE: PRT															
<213> ORGANISM: Homo sapiens															
<400> SEQUENCE: 38															
Asp	Ile	Gln	Met	Thr	Gln	Ser	Pro	Ser	Ser	Leu	Ser	Ala	Ser	Val	Gly
1				5					10					15	
Asp	Arg	Val	Thr	Ile	Thr	Cys	Gln	Ala	Ser	Gln	Ser	Ile	Asn	Asn	Gln
		20						25					30		
Leu	Ser	Trp	Tyr	Gln	Gln	Lys	Pro	Gly	Lys	Ala	Pro	Lys	Leu	Leu	Ile
		35					40					45			
Tyr	Tyr	Ala	Ser	Thr	Leu	Ala	Ser	Gly	Val	Pro	Ser	Arg	Phe	Ser	Gly
	50					55				60					
Ser	Gly	Ser	Gly	Thr	Asp	Phe	Thr	Leu	Thr	Ile	Ser	Ser	Leu	Gln	Pro
	65				70					75					80
Glu	Asp	Phe	Ala	Thr	Tyr	Tyr	Cys	Gln	Gly	Ser	Tyr	Tyr	Ser	Gly	Gly
				85					90					95	
Trp	Asp	Tyr	Gly	Phe	Gly	Gln	Gly	Thr	Lys	Val	Glu	Ile	Lys		
		100						105					110		
<210> SEQ ID NO 39															
<211> LENGTH: 448															
<212> TYPE: PRT															
<213> ORGANISM: Homo sapiens															
<400> SEQUENCE: 39															
Glu	Val	Gln	Leu	Val	Glu	Ser	Gly	Gly	Gly	Leu	Val	Gln	Pro	Gly	Gly
1				5					10					15	
Ser	Leu	Arg	Leu	Ser	Cys	Ala	Ala	Ser	Gly	Phe	Ser	Phe	Ser	Gly	Arg
		20						25					30		
Tyr	Trp	Ile	Gln	Trp	Val	Arg	Gln	Ala	Pro	Gly	Lys	Gly	Leu	Glu	Trp
		35					40					45			
Val	Ala	Ser	Val	Trp	Pro	Gly	Phe	Thr	Gly	Asp	Thr	Asn	Tyr	Ala	Asn
	50					55				60					
Trp	Ala	Lys	Gly	Arg	Phe	Thr	Ile	Ser	Arg	Asp	Asp	Ser	Lys	Asn	Thr
	65				70					75					80
Leu	Tyr	Leu	Gln	Met	Asn	Ser	Leu	Arg	Ala	Glu	Asp	Thr	Ala	Val	Tyr
				85					90					95	
Tyr	Cys	Ala	Arg	Glu	Pro	Val	Ala	Trp	Gly	Gly	Gly	Leu	Asp	Leu	Trp
			100					105					110		

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Gly	Gln	Gly	Thr	Leu	Val	Thr	Val	Ser	Ser	Ala	Ser	Thr	Lys	Gly	Pro
		115					120					125			
Ser	Val	Phe	Pro	Leu	Ala	Pro	Cys	Ser	Arg	Ser	Thr	Ser	Glu	Ser	Thr
	130					135					140				
Ala	Ala	Leu	Gly	Cys	Leu	Val	Lys	Asp	Tyr	Phe	Pro	Glu	Pro	Val	Thr
145					150					155					160
Val	Ser	Trp	Asn	Ser	Gly	Ala	Leu	Thr	Ser	Gly	Val	His	Thr	Phe	Pro
			165						170					175	
Ala	Val	Leu	Gln	Ser	Ser	Gly	Leu	Tyr	Ser	Leu	Ser	Ser	Val	Val	Thr
			180					185					190		
Val	Pro	Ser	Ser	Asn	Phe	Gly	Thr	Gln	Thr	Tyr	Thr	Cys	Asn	Val	Asp
		195					200					205			
His	Lys	Pro	Ser	Asn	Thr	Lys	Val	Asp	Lys	Thr	Val	Glu	Arg	Lys	Cys
	210					215					220				
Cys	Val	Glu	Cys	Pro	Pro	Cys	Pro	Ala	Pro	Pro	Val	Ala	Gly	Pro	Ser
225					230					235					240
Val	Phe	Leu	Phe	Pro	Pro	Lys	Pro	Lys	Asp	Thr	Leu	Met	Ile	Ser	Arg
			245						250					255	
Thr	Pro	Glu	Val	Thr	Cys	Val	Val	Val	Asp	Val	Ser	Gln	Glu	Asp	Pro
			260					265					270		
Glu	Val	Gln	Phe	Asn	Trp	Tyr	Val	Asp	Gly	Val	Glu	Val	His	Asn	Ala
		275					280					285			
Lys	Thr	Lys	Pro	Arg	Glu	Glu	Gln	Phe	Asn	Ser	Thr	Tyr	Arg	Val	Val
	290					295					300				
Ser	Val	Leu	Thr	Val	Leu	His	Gln	Asp	Trp	Leu	Asn	Gly	Lys	Glu	Tyr
305					310					315					320
Lys	Cys	Lys	Val	Ser	Asn	Lys	Gly	Leu	Pro	Ser	Ser	Ile	Glu	Lys	Thr
			325						330					335	
Ile	Ser	Lys	Ala	Lys	Gly	Gln	Pro	Arg	Glu	Pro	Gln	Val	Tyr	Thr	Leu
			340					345					350		
Pro	Pro	Ser	Gln	Glu	Glu	Met	Thr	Lys	Asn	Gln	Val	Ser	Leu	Thr	Cys
		355					360					365			
Leu	Val	Lys	Gly	Phe	Tyr	Pro	Ser	Asp	Ile	Ala	Val	Glu	Trp	Glu	Ser
	370					375					380				
Asn	Gly	Gln	Pro	Glu	Asn	Asn	Tyr	Lys	Thr	Thr	Pro	Pro	Val	Leu	Asp
385					390					395					400
Ser	Asp	Gly	Ser	Phe	Phe	Leu	Tyr	Ser	Arg	Leu	Thr	Val	Asp	Lys	Ser
			405						410					415	
Arg	Trp	Gln	Glu	Gly	Asn	Val	Phe	Ser	Cys	Ser	Val	Met	His	Glu	Ala
		420						425					430		
Leu	His	Asn	His	Tyr	Thr	Gln	Lys	Ser	Leu	Ser	Leu	Ser	Leu	Gly	Lys
		435					440					445			
<210> SEQ ID NO 40															
<211> LENGTH: 217															
<212> TYPE: PRT															
<213> ORGANISM: Homo sapiens															
<400> SEQUENCE: 40															
Asp	Ile	Gln	Met	Thr	Gln	Ser	Pro	Ser	Ser	Leu	Ser	Ala	Ser	Val	Gly
1				5					10					15	
Asp	Arg	Val	Thr	Ile	Thr	Cys	Gln	Ala	Ser	Gln	Ser	Ile	Asn	Asn	Gln
		20						25					30		
Leu	Ser	Trp	Tyr	Gln	Gln	Lys	Pro	Gly	Lys	Ala	Pro	Lys	Leu	Leu	Ile
		35					40					45			

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Tyr	Tyr	Ala	Ser	Thr	Leu	Ala	Ser	Gly	Val	Pro	Ser	Arg	Phe	Ser	Gly	
	50					55				60						
Ser	Gly	Ser	Gly	Thr	Asp	Phe	Thr	Leu	Thr	Ile	Ser	Ser	Leu	Gln	Pro	
65					70					75					80	
Glu	Asp	Phe	Ala	Thr	Tyr	Tyr	Cys	Gln	Gly	Ser	Tyr	Tyr	Ser	Gly	Gly	
				85					90					95		
Trp	Asp	Tyr	Gly	Phe	Gly	Gln	Gly	Thr	Lys	Val	Glu	Ile	Lys	Arg	Thr	
			100					105						110		
Val	Ala	Ala	Pro	Ser	Val	Phe	Ile	Phe	Pro	Pro	Ser	Asp	Glu	Gln	Leu	
		115					120					125				
Lys	Ser	Gly	Thr	Ala	Ser	Val	Val	Cys	Leu	Leu	Asn	Asn	Phe	Tyr	Pro	
	130					135					140					
Arg	Glu	Ala	Lys	Val	Gln	Trp	Lys	Val	Asp	Asn	Ala	Leu	Gln	Ser	Gly	
145					150					155					160	
Asn	Ser	Gln	Glu	Ser	Val	Thr	Glu	Gln	Asp	Ser	Lys	Asp	Ser	Thr	Tyr	
				165					170					175		
Ser	Leu	Ser	Ser	Thr	Leu	Thr	Leu	Ser	Lys	Ala	Asp	Tyr	Glu	Lys	His	
			180					185					190			
Lys	Val	Tyr	Ala	Cys	Glu	Val	Thr	His	Gln	Gly	Leu	Ser	Ser	Pro	Val	
		195					200					205				
Thr	Lys	Ser	Phe	Asn	Arg	Gly	Glu	Cys								
	210					215										
<210> SEQ ID NO 41																
<211> LENGTH: 11																
<212> TYPE: PRT																
<213> ORGANISM: Homo sapiens																
<400> SEQUENCE: 41																
Gly	Phe	Ser	Leu	Ser	Gly	Arg	Tyr	Trp	Ile	Gln						
1				5					10							
<210> SEQ ID NO 42																
<211> LENGTH: 18																
<212> TYPE: PRT																
<213> ORGANISM: Homo sapiens																
<400> SEQUENCE: 42																
Ser	Gly	Trp	Pro	Gly	Ala	Thr	Gly	Asp	Thr	Asn	Tyr	Ala	Asn	Trp	Ala	
1				5					10					15		
Lys Gly																
<210> SEQ ID NO 43																
<211> LENGTH: 11																
<212> TYPE: PRT																
<213> ORGANISM: Homo sapiens																
<400> SEQUENCE: 43																
Glu	Pro	Val	Ala	Trp	Gly	Gly	Gly	Leu	Asp	Leu						
1				5				10								
<210> SEQ ID NO 44																
<211> LENGTH: 11																
<212> TYPE: PRT																
<213> ORGANISM: Homo sapiens																
<400> SEQUENCE: 44																
Gln	Ala	Ser	Gln	Ser	Ile	Asn	Asn	Gln	Leu	Ser						
1				5					10							

<210> SEQ ID NO 45
<211> LENGTH: 7
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 45

Tyr Ala Ser Thr Leu Ala Ser
1 5

<210> SEQ ID NO 46
<211> LENGTH: 12
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 46

Gln Gly Ser Tyr Tyr Ser Gly Gly Trp Asp Tyr Gly
1 5 10

<210> SEQ ID NO 47
<211> LENGTH: 122
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 47

Glu Val Gln Leu Val Glu Ser Gly Gly Gly Leu Val Gln Pro Gly Gly
1 5 10 15
Ser Leu Arg Leu Ser Cys Ala Ala Ser Gly Phe Ser Leu Ser Gly Arg
20 25 30
Tyr Trp Ile Gln Trp Val Arg Gln Ala Pro Gly Lys Gly Leu Glu Trp
35 40 45
Val Ala Ser Gly Trp Pro Gly Ala Thr Gly Asp Thr Asn Tyr Ala Asn
50 55 60
Trp Ala Lys Gly Arg Phe Thr Ile Ser Arg Asp Asp Ser Lys Asn Thr
65 70 75 80
Leu Tyr Leu Gln Met Asn Ser Leu Arg Ala Glu Asp Thr Ala Val Tyr
85 90 95
Tyr Cys Ala Arg Glu Pro Val Ala Trp Gly Gly Gly Leu Asp Leu Trp
100 105 110
Gly Gln Gly Thr Leu Val Thr Val Ser Ser
115 120

<210> SEQ ID NO 48
<211> LENGTH: 110
<212> TYPE: PRT
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 48

Asp Ile Gln Met Thr Gln Ser Pro Ser Ser Leu Ser Ala Ser Val Gly
1 5 10 15
Asp Arg Val Thr Ile Thr Cys Gln Ala Ser Gln Ser Ile Asn Asn Gln
20 25 30
Leu Ser Trp Tyr Gln Gln Lys Pro Gly Lys Ala Pro Lys Leu Leu Ile
35 40 45
Tyr Tyr Ala Ser Thr Leu Ala Ser Gly Val Pro Ser Arg Phe Ser Gly
50 55 60
Ser Gly Ser Gly Thr Asp Phe Thr Leu Thr Ile Ser Ser Leu Gln Pro
65 70 75 80
Glu Asp Phe Ala Thr Tyr Tyr Cys Gln Gly Ser Tyr Tyr Ser Gly Gly

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85					90					95				
Trp	Asp	Tyr	Gly	Phe	Gly	Gln	Gly	Thr	Lys	Val	Glu	Ile	Lys	
			100					105					110	
<210> SEQ ID NO 49														
<211> LENGTH: 448														
<212> TYPE: PRT														
<213> ORGANISM: Homo sapiens														
<400> SEQUENCE: 49														
Glu	Val	Gln	Leu	Val	Glu	Ser	Gly	Gly	Gly	Leu	Val	Gln	Pro	Gly
1				5					10					15
Ser	Leu	Arg	Leu	Ser	Cys	Ala	Ala	Ser	Gly	Phe	Ser	Leu	Ser	Gly
			20					25					30	Arg
Tyr	Trp	Ile	Gln	Trp	Val	Arg	Gln	Ala	Pro	Gly	Lys	Gly	Leu	Glu
		35					40					45		Trp
Val	Ala	Ser	Gly	Trp	Pro	Gly	Ala	Thr	Gly	Asp	Thr	Asn	Tyr	Ala
	50					55					60			Asn
Trp	Ala	Lys	Gly	Arg	Phe	Thr	Ile	Ser	Arg	Asp	Asp	Ser	Lys	Asn
65					70					75				80
Leu	Tyr	Leu	Gln	Met	Asn	Ser	Leu	Arg	Ala	Glu	Asp	Thr	Ala	Val
				85					90					95
Tyr	Cys	Ala	Arg	Glu	Pro	Val	Ala	Trp	Gly	Gly	Gly	Leu	Asp	Leu
			100					105					110	Trp
Gly	Gln	Gly	Thr	Leu	Val	Thr	Val	Ser	Ser	Ala	Ser	Thr	Lys	Gly
		115					120					125		Pro
Ser	Val	Phe	Pro	Leu	Ala	Pro	Cys	Ser	Arg	Ser	Thr	Ser	Glu	Ser
	130					135					140			Thr
Ala	Ala	Leu	Gly	Cys	Leu	Val	Lys	Asp	Tyr	Phe	Pro	Glu	Pro	Val
145					150					155				160
Val	Ser	Trp	Asn	Ser	Gly	Ala	Leu	Thr	Ser	Gly	Val	His	Thr	Phe
			165					170					175	Pro
Ala	Val	Leu	Gln	Ser	Ser	Gly	Leu	Tyr	Ser	Leu	Ser	Ser	Val	Val
		180						185					190	Thr
Val	Pro	Ser	Ser	Asn	Phe	Gly	Thr	Gln	Thr	Tyr	Thr	Cys	Asn	Val
	195						200					205		Asp
His	Lys	Pro	Ser	Asn	Thr	Lys	Val	Asp	Lys	Thr	Val	Glu	Arg	Lys
	210					215					220			Cys
Cys	Val	Glu	Cys	Pro	Pro	Cys	Pro	Ala	Pro	Pro	Val	Ala	Gly	Pro
225					230					235				240
Val	Phe	Leu	Phe	Pro	Pro	Lys	Pro	Lys	Asp	Thr	Leu	Met	Ile	Ser
			245						250				255	Arg
Thr	Pro	Glu	Val	Thr	Cys	Val	Val	Val	Asp	Val	Ser	Gln	Glu	Asp
		260						265					270	Pro
Glu	Val	Gln	Phe	Asn	Trp	Tyr	Val	Asp	Gly	Val	Glu	Val	His	Asn
		275					280					285		Ala
Lys	Thr	Lys	Pro	Arg	Glu	Glu	Gln	Phe	Asn	Ser	Thr	Tyr	Arg	Val
	290						295				300			Val
Ser	Val	Leu	Thr	Val	Leu	His	Gln	Asp	Trp	Leu	Asn	Gly	Lys	Glu
305					310					315				320
Lys	Cys	Lys	Val	Ser	Asn	Lys	Gly	Leu	Pro	Ser	Ser	Ile	Glu	Lys
			325					330					335	Thr
Ile	Ser	Lys	Ala	Lys	Gly	Gln	Pro	Arg	Glu	Pro	Gln	Val	Tyr	Thr
		340						345					350	Leu

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Pro	Pro	Ser	Gln	Glu	Glu	Met	Thr	Lys	Asn	Gln	Val	Ser	Leu	Thr	Cys
		355					360					365			
Leu	Val	Lys	Gly	Phe	Tyr	Pro	Ser	Asp	Ile	Ala	Val	Glu	Trp	Glu	Ser
	370					375					380				
Asn	Gly	Gln	Pro	Glu	Asn	Asn	Tyr	Lys	Thr	Thr	Pro	Pro	Val	Leu	Asp
385					390					395					400
Ser	Asp	Gly	Ser	Phe	Phe	Leu	Tyr	Ser	Arg	Leu	Thr	Val	Asp	Lys	Ser
				405					410					415	
Arg	Trp	Gln	Glu	Gly	Asn	Val	Phe	Ser	Cys	Ser	Val	Met	His	Glu	Ala
			420					425					430		
Leu	His	Asn	His	Tyr	Thr	Gln	Lys	Ser	Leu	Ser	Leu	Ser	Leu	Gly	Lys
		435					440					445			
<210> SEQ ID NO 50															
<211> LENGTH: 217															
<212> TYPE: PRT															
<213> ORGANISM: Homo sapiens															
<400> SEQUENCE: 50															
Asp	Ile	Gln	Met	Thr	Gln	Ser	Pro	Ser	Ser	Leu	Ser	Ala	Ser	Val	Gly
1				5					10					15	
Asp	Arg	Val	Thr	Ile	Thr	Cys	Gln	Ala	Ser	Gln	Ser	Ile	Asn	Asn	Gln
			20					25					30		
Leu	Ser	Trp	Tyr	Gln	Gln	Lys	Pro	Gly	Lys	Ala	Pro	Lys	Leu	Leu	Ile
		35					40					45			
Tyr	Tyr	Ala	Ser	Thr	Leu	Ala	Ser	Gly	Val	Pro	Ser	Arg	Phe	Ser	Gly
	50					55					60				
Ser	Gly	Ser	Gly	Thr	Asp	Phe	Thr	Leu	Thr	Ile	Ser	Ser	Leu	Gln	Pro
65					70					75					80
Glu	Asp	Phe	Ala	Thr	Tyr	Tyr	Cys	Gln	Gly	Ser	Tyr	Tyr	Ser	Gly	Gly
				85					90					95	
Trp	Asp	Tyr	Gly	Phe	Gly	Gln	Gly	Thr	Lys	Val	Glu	Ile	Lys	Arg	Thr
		100						105					110		
Val	Ala	Ala	Pro	Ser	Val	Phe	Ile	Phe	Pro	Pro	Ser	Asp	Glu	Gln	Leu
		115					120					125			
Lys	Ser	Gly	Thr	Ala	Ser	Val	Val	Cys	Leu	Leu	Asn	Asn	Phe	Tyr	Pro
	130					135					140				
Arg	Glu	Ala	Lys	Val	Gln	Trp	Lys	Val	Asp	Asn	Ala	Leu	Gln	Ser	Gly
145					150					155					160
Asn	Ser	Gln	Glu	Ser	Val	Thr	Glu	Gln	Asp	Ser	Lys	Asp	Ser	Thr	Tyr
			165						170					175	
Ser	Leu	Ser	Ser	Thr	Leu	Thr	Leu	Ser	Lys	Ala	Asp	Tyr	Glu	Lys	His
			180					185					190		
Lys	Val	Tyr	Ala	Cys	Glu	Val	Thr	His	Gln	Gly	Leu	Ser	Ser	Pro	Val
		195					200					205			
Thr	Lys	Ser	Phe	Asn	Arg	Gly	Glu	Cys							
	210					215									
<210> SEQ ID NO 51															
<211> LENGTH: 11															
<212> TYPE: PRT															
<213> ORGANISM: Homo sapiens															
<400> SEQUENCE: 51															
Gly	Phe	Ser	Leu	Ser	Gly	Arg	Tyr	Trp	Ile	Gln					
1				5					10						

Trp Ala Lys Gly Arg Phe Thr Ile Ser Arg Asp Asp Ser Lys Asn Thr
65 70 75 80

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Leu	Tyr	Leu	Gln	Met	Asn	Ser	Leu	Arg	Ala	Glu	Asp	Thr	Ala	Val	Tyr	
				85					90					95		
Tyr	Cys	Ala	Arg	Glu	Pro	Val	Ala	Trp	Gly	Gly	Gly	Leu	Asp	Leu	Trp	
			100					105					110			
Gly	Gln	Gly	Thr	Leu	Val	Thr	Val	Ser	Ser							
	115						120									
<210> SEQ ID NO 58																
<211> LENGTH: 110																
<212> TYPE: PRT																
<213> ORGANISM: Homo sapiens																
<400> SEQUENCE: 58																
Asp	Ile	Gln	Met	Thr	Gln	Ser	Pro	Ser	Ser	Leu	Ser	Ala	Ser	Val	Gly	
1				5					10					15		
Asp	Arg	Val	Thr	Ile	Thr	Cys	Gln	Ala	Ser	Gln	Ser	Ile	Asn	Asn	Gln	
			20					25					30			
Leu	Ser	Trp	Tyr	Gln	Gln	Lys	Pro	Gly	Lys	Ala	Pro	Lys	Leu	Leu	Ile	
		35					40					45				
Tyr	Tyr	Ala	Ser	Thr	Leu	Ala	Ser	Gly	Val	Pro	Ser	Arg	Phe	Ser	Gly	
	50					55					60					
Ser	Gly	Ser	Gly	Thr	Asp	Phe	Thr	Leu	Thr	Ile	Ser	Ser	Leu	Gln	Pro	
65					70					75					80	
Glu	Asp	Phe	Ala	Thr	Tyr	Tyr	Cys	Gln	Gly	Ser	Tyr	Tyr	Ser	Gly	Gly	
				85					90					95		
Trp	Asp	Tyr	Gly	Phe	Gly	Gln	Gly	Thr	Lys	Val	Glu	Ile	Lys			
		100						105					110			
<210> SEQ ID NO 59																
<211> LENGTH: 448																
<212> TYPE: PRT																
<213> ORGANISM: Homo sapiens																
<400> SEQUENCE: 59																
Glu	Val	Gln	Leu	Val	Glu	Ser	Gly	Gly	Gly	Leu	Val	Gln	Pro	Gly	Gly	
1				5					10					15		
Ser	Leu	Arg	Leu	Ser	Cys	Ala	Ala	Ser	Gly	Phe	Ser	Leu	Ser	Gly	Arg	
			20					25					30			
Tyr	Trp	Ile	Gln	Trp	Val	Arg	Gln	Ala	Pro	Gly	Lys	Gly	Leu	Glu	Trp	
		35					40					45				
Val	Ala	Ser	Val	Trp	Pro	Gly	Phe	Thr	Gly	Asp	Thr	Asn	Tyr	Ala	Asn	
	50					55					60					
Trp	Ala	Lys	Gly	Arg	Phe	Thr	Ile	Ser	Arg	Asp	Asp	Ser	Lys	Asn	Thr	
65					70					75					80	
Leu	Tyr	Leu	Gln	Met	Asn	Ser	Leu	Arg	Ala	Glu	Asp	Thr	Ala	Val	Tyr	
			85						90					95		
Tyr	Cys	Ala	Arg	Glu	Pro	Val	Ala	Trp	Gly	Gly	Gly	Leu	Asp	Leu	Trp	
			100					105					110			
Gly	Gln	Gly	Thr	Leu	Val	Thr	Val	Ser	Ser	Ala	Ser	Thr	Lys	Gly	Pro	
	115						120					125				
Ser	Val	Phe	Pro	Leu	Ala	Pro	Cys	Ser	Arg	Ser	Thr	Ser	Glu	Ser	Thr	
	130					135					140					
Ala	Ala	Leu	Gly	Cys	Leu	Val	Lys	Asp	Tyr	Phe	Pro	Glu	Pro	Val	Thr	
145					150					155					160	
Val	Ser	Trp	Asn	Ser	Gly	Ala	Leu	Thr	Ser	Gly	Val	His	Thr	Phe	Pro	
			165						170					175		

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Ala	Val	Leu	Gln	Ser	Ser	Gly	Leu	Tyr	Ser	Leu	Ser	Ser	Val	Val	Thr	
			180					185					190			
Val	Pro	Ser	Ser	Asn	Phe	Gly	Thr	Gln	Thr	Tyr	Thr	Cys	Asn	Val	Asp	
		195					200					205				
His	Lys	Pro	Ser	Asn	Thr	Lys	Val	Asp	Lys	Thr	Val	Glu	Arg	Lys	Cys	
	210					215					220					
Cys	Val	Glu	Cys	Pro	Pro	Cys	Pro	Ala	Pro	Pro	Val	Ala	Gly	Pro	Ser	
225					230					235					240	
Val	Phe	Leu	Phe	Pro	Pro	Lys	Pro	Lys	Asp	Thr	Leu	Met	Ile	Ser	Arg	
				245					250					255		
Thr	Pro	Glu	Val	Thr	Cys	Val	Val	Val	Asp	Val	Ser	Gln	Glu	Asp	Pro	
			260					265					270			
Glu	Val	Gln	Phe	Asn	Trp	Tyr	Val	Asp	Gly	Val	Glu	Val	His	Asn	Ala	
		275					280					285				
Lys	Thr	Lys	Pro	Arg	Glu	Glu	Gln	Phe	Asn	Ser	Thr	Tyr	Arg	Val	Val	
	290					295					300					
Ser	Val	Leu	Thr	Val	Leu	His	Gln	Asp	Trp	Leu	Asn	Gly	Lys	Glu	Tyr	
305					310					315					320	
Lys	Cys	Lys	Val	Ser	Asn	Lys	Gly	Leu	Pro	Ser	Ser	Ile	Glu	Lys	Thr	
				325					330					335		
Ile	Ser	Lys	Ala	Lys	Gly	Gln	Pro	Arg	Glu	Pro	Gln	Val	Tyr	Thr	Leu	
			340					345					350			
Pro	Pro	Ser	Gln	Glu	Glu	Met	Thr	Lys	Asn	Gln	Val	Ser	Leu	Thr	Cys	
		355					360					365				
Leu	Val	Lys	Gly	Phe	Tyr	Pro	Ser	Asp	Ile	Ala	Val	Glu	Trp	Glu	Ser	
	370					375					380					
Asn	Gly	Gln	Pro	Glu	Asn	Asn	Tyr	Lys	Thr	Thr	Pro	Pro	Val	Leu	Asp	
385					390					395					400	
Ser	Asp	Gly	Ser	Phe	Phe	Leu	Tyr	Ser	Arg	Leu	Thr	Val	Asp	Lys	Ser	
				405					410					415		
Arg	Trp	Gln	Glu	Gly	Asn	Val	Phe	Ser	Cys	Ser	Val	Met	His	Glu	Ala	
		420						425					430			
Leu	His	Asn	His	Tyr	Thr	Gln	Lys	Ser	Leu	Ser	Leu	Ser	Leu	Gly	Lys	
		435					440					445				
<210> SEQ ID NO 60																
<211> LENGTH: 217																
<212> TYPE: PRT																
<213> ORGANISM: Homo sapiens																
<400> SEQUENCE: 60																
Asp	Ile	Gln	Met	Thr	Gln	Ser	Pro	Ser	Ser	Leu	Ser	Ala	Ser	Val	Gly	
1				5					10					15		
Asp	Arg	Val	Thr	Ile	Thr	Cys	Gln	Ala	Ser	Gln	Ser	Ile	Asn	Asn	Gln	
		20						25					30			
Leu	Ser	Trp	Tyr	Gln	Gln	Lys	Pro	Gly	Lys	Ala	Pro	Lys	Leu	Leu	Ile	
		35					40					45				
Tyr	Tyr	Ala	Ser	Thr	Leu	Ala	Ser	Gly	Val	Pro	Ser	Arg	Phe	Ser	Gly	
	50					55					60					
Ser	Gly	Ser	Gly	Thr	Asp	Phe	Thr	Leu	Thr	Ile	Ser	Ser	Leu	Gln	Pro	
65					70					75				80		
Glu	Asp	Phe	Ala	Thr	Tyr	Tyr	Cys	Gln	Gly	Ser	Tyr	Tyr	Ser	Gly	Gly	
			85						90					95		
Trp	Asp	Tyr	Gly	Phe	Gly	Gln	Gly	Thr	Lys	Val	Glu	Ile	Lys	Arg	Thr	

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100					105					110						
Val	Ala	Ala	Pro	Ser	Val	Phe	Ile	Phe	Pro	Pro	Ser	Asp	Glu	Gln	Leu	
115					120					125						
Lys	Ser	Gly	Thr	Ala	Ser	Val	Val	Cys	Leu	Leu	Asn	Asn	Phe	Tyr	Pro	
130					135					140						
Arg	Glu	Ala	Lys	Val	Gln	Trp	Lys	Val	Asp	Asn	Ala	Leu	Gln	Ser	Gly	
145					150					155					160	
Asn	Ser	Gln	Glu	Ser	Val	Thr	Glu	Gln	Asp	Ser	Lys	Asp	Ser	Thr	Tyr	
165					170					175						
Ser	Leu	Ser	Ser	Thr	Leu	Thr	Leu	Ser	Lys	Ala	Asp	Tyr	Glu	Lys	His	
180					185					190						
Lys	Val	Tyr	Ala	Cys	Glu	Val	Thr	His	Gln	Gly	Leu	Ser	Ser	Pro	Val	
195					200					205						
Thr	Lys	Ser	Phe	Asn	Arg	Gly	Glu	Cys								
210					215											
<210> SEQ ID NO 61																
<211> LENGTH: 1676																
<212> TYPE: PRT																
<213> ORGANISM: Homo sapiens																
<400> SEQUENCE: 61																
Met	Gly	Leu	Leu	Gly	Ile	Leu	Cys	Phe	Leu	Ile	Phe	Leu	Gly	Lys	Thr	
1				5				10				15				
Trp	Gly	Gln	Glu	Gln	Thr	Tyr	Val	Ile	Ser	Ala	Pro	Lys	Ile	Phe	Arg	
20					25					30						
Val	Gly	Ala	Ser	Glu	Asn	Ile	Val	Ile	Gln	Val	Tyr	Gly	Tyr	Thr	Glu	
35				40				45								
Ala	Phe	Asp	Ala	Thr	Ile	Ser	Ile	Lys	Ser	Tyr	Pro	Asp	Lys	Lys	Phe	
50				55				60								
Ser	Tyr	Ser	Ser	Gly	His	Val	His	Leu	Ser	Ser	Glu	Asn	Lys	Phe	Gln	
65				70				75				80				
Asn	Ser	Ala	Ile	Leu	Thr	Ile	Gln	Pro	Lys	Gln	Leu	Pro	Gly	Gly	Gln	
85					90					95						
Asn	Pro	Val	Ser	Tyr	Val	Tyr	Leu	Glu	Val	Val	Ser	Lys	His	Phe	Ser	
100					105					110						
Lys	Ser	Lys	Arg	Met	Pro	Ile	Thr	Tyr	Asp	Asn	Gly	Phe	Leu	Phe	Ile	
115					120					125						
His	Thr	Asp	Lys	Pro	Val	Tyr	Thr	Pro	Asp	Gln	Ser	Val	Lys	Val	Arg	
130					135					140						
Val	Tyr	Ser	Leu	Asn	Asp	Asp	Leu	Lys	Pro	Ala	Lys	Arg	Glu	Thr	Val	
145					150					155					160	
Leu	Thr	Phe	Ile	Asp	Pro	Glu	Gly	Ser	Glu	Val	Asp	Met	Val	Glu	Glu	
165					170					175						
Ile	Asp	His	Ile	Gly	Ile	Ile	Ser	Phe	Pro	Asp	Phe	Lys	Ile	Pro	Ser	
180					185					190						
Asn	Pro	Arg	Tyr	Gly	Met	Trp	Thr	Ile	Lys	Ala	Lys	Tyr	Lys	Glu	Asp	
195					200					205						
Phe	Ser	Thr	Thr	Gly	Thr	Ala	Tyr	Phe	Glu	Val	Lys	Glu	Tyr	Val	Leu	
210					215					220						
Pro	His	Phe	Ser	Val	Ser	Ile	Glu	Pro	Glu	Tyr	Asn	Phe	Ile	Gly	Tyr	
225					230					235					240	
Lys	Asn	Phe	Lys	Asn	Phe	Glu	Ile	Thr	Ile	Lys	Ala	Arg	Tyr	Phe	Tyr	
245					250					255						

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Asn	Lys	Val	Val	Thr	Glu	Ala	Asp	Val	Tyr	Ile	Thr	Phe	Gly	Ile	Arg
		260						265					270		
Glu	Asp	Leu	Lys	Asp	Asp	Gln	Lys	Glu	Met	Met	Gln	Thr	Ala	Met	Gln
		275					280					285			
Asn	Thr	Met	Leu	Ile	Asn	Gly	Ile	Ala	Gln	Val	Thr	Phe	Asp	Ser	Glu
	290					295					300				
Thr	Ala	Val	Lys	Glu	Leu	Ser	Tyr	Tyr	Ser	Leu	Glu	Asp	Leu	Asn	Asn
305					310					315					320
Lys	Tyr	Leu	Tyr	Ile	Ala	Val	Thr	Val	Ile	Glu	Ser	Thr	Gly	Gly	Phe
				325					330					335	
Ser	Glu	Glu	Ala	Glu	Ile	Pro	Gly	Ile	Lys	Tyr	Val	Leu	Ser	Pro	Tyr
			340					345					350		
Lys	Leu	Asn	Leu	Val	Ala	Thr	Pro	Leu	Phe	Leu	Lys	Pro	Gly	Ile	Pro
	355						360					365			
Tyr	Pro	Ile	Lys	Val	Gln	Val	Lys	Asp	Ser	Leu	Asp	Gln	Leu	Val	Gly
	370				375						380				
Gly	Val	Pro	Val	Thr	Leu	Asn	Ala	Gln	Thr	Ile	Asp	Val	Asn	Gln	Glu
385					390					395					400
Thr	Ser	Asp	Leu	Asp	Pro	Ser	Lys	Ser	Val	Thr	Arg	Val	Asp	Asp	Gly
			405						410					415	
Val	Ala	Ser	Phe	Val	Leu	Asn	Leu	Pro	Ser	Gly	Val	Thr	Val	Leu	Glu
			420					425					430		
Phe	Asn	Val	Lys	Thr	Asp	Ala	Pro	Asp	Leu	Pro	Glu	Glu	Asn	Gln	Ala
	435						440					445			
Arg	Glu	Gly	Tyr	Arg	Ala	Ile	Ala	Tyr	Ser	Ser	Leu	Ser	Gln	Ser	Tyr
	450					455					460				
Leu	Tyr	Ile	Asp	Trp	Thr	Asp	Asn	His	Lys	Ala	Leu	Leu	Val	Gly	Glu
465					470					475					480
His	Leu	Asn	Ile	Ile	Val	Thr	Pro	Lys	Ser	Pro	Tyr	Ile	Asp	Lys	Ile
			485						490					495	
Thr	His	Tyr	Asn	Tyr	Leu	Ile	Leu	Ser	Lys	Gly	Lys	Ile	Ile	His	Phe
			500					505					510		
Gly	Thr	Arg	Glu	Lys	Phe	Ser	Asp	Ala	Ser	Tyr	Gln	Ser	Ile	Asn	Ile
		515					520					525			
Pro	Val	Thr	Gln	Asn	Met	Val	Pro	Ser	Ser	Arg	Leu	Leu	Val	Tyr	Tyr
	530					535					540				
Ile	Val	Thr	Gly	Glu	Gln	Thr	Ala	Glu	Leu	Val	Ser	Asp	Ser	Val	Trp
545					550					555					560
Leu	Asn	Ile	Glu	Glu	Lys	Cys	Gly	Asn	Gln	Leu	Gln	Val	His	Leu	Ser
			565						570					575	
Pro	Asp	Ala	Asp	Ala	Tyr	Ser	Pro	Gly	Gln	Thr	Val	Ser	Leu	Asn	Met
		580						585					590		
Ala	Thr	Gly	Met	Asp	Ser	Trp	Val	Ala	Leu	Ala	Ala	Val	Asp	Ser	Ala
		595					600					605			
Val	Tyr	Gly	Val	Gln	Arg	Gly	Ala	Lys	Lys	Pro	Leu	Glu	Arg	Val	Phe
	610					615					620				
Gln	Phe	Leu	Glu	Lys	Ser	Asp	Leu	Gly	Cys	Gly	Ala	Gly	Gly	Gly	Leu
625					630					635					640
Asn	Asn	Ala	Asn	Val	Phe	His	Leu	Ala	Gly	Leu	Thr	Phe	Leu	Thr	Asn
			645						650				655		
Ala	Asn	Ala	Asp	Asp	Ser	Gln	Glu	Asn	Asp	Glu	Pro	Cys	Lys	Glu	Ile
		660						665					670		
Leu	Arg	Pro	Arg	Arg	Thr	Leu	Gln	Lys	Lys	Ile	Glu	Glu	Ile	Ala	Ala

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675					680					685					
Lys	Tyr	Lys	His	Ser	Val	Val	Lys	Lys	Cys	Cys	Tyr	Asp	Gly	Ala	Cys
690						695					700				
Val	Asn	Asn	Asp	Glu	Thr	Cys	Glu	Gln	Arg	Ala	Ala	Arg	Ile	Ser	Leu
705					710					715					720
Gly	Pro	Arg	Cys	Ile	Lys	Ala	Phe	Thr	Glu	Cys	Cys	Val	Val	Ala	Ser
				725					730					735	
Gln	Leu	Arg	Ala	Asn	Ile	Ser	His	Lys	Asp	Met	Gln	Leu	Gly	Arg	Leu
			740					745					750		
His	Met	Lys	Thr	Leu	Leu	Pro	Val	Ser	Lys	Pro	Glu	Ile	Arg	Ser	Tyr
		755					760					765			
Phe	Pro	Glu	Ser	Trp	Leu	Trp	Glu	Val	His	Leu	Val	Pro	Arg	Arg	Lys
	770					775					780				
Gln	Leu	Gln	Phe	Ala	Leu	Pro	Asp	Ser	Leu	Thr	Thr	Trp	Glu	Ile	Gln
785					790					795					800
Gly	Val	Gly	Ile	Ser	Asn	Thr	Gly	Ile	Cys	Val	Ala	Asp	Thr	Val	Lys
				805					810					815	
Ala	Lys	Val	Phe	Lys	Asp	Val	Phe	Leu	Glu	Met	Asn	Ile	Pro	Tyr	Ser
			820					825					830		
Val	Val	Arg	Gly	Glu	Gln	Ile	Gln	Leu	Lys	Gly	Thr	Val	Tyr	Asn	Tyr
		835					840					845			
Arg	Thr	Ser	Gly	Met	Gln	Phe	Cys	Val	Lys	Met	Ser	Ala	Val	Glu	Gly
	850					855					860				
Ile	Cys	Thr	Ser	Glu	Ser	Pro	Val	Ile	Asp	His	Gln	Gly	Thr	Lys	Ser
865					870					875					880
Ser	Lys	Cys	Val	Arg	Gln	Lys	Val	Glu	Gly	Ser	Ser	Ser	His	Leu	Val
				885					890					895	
Thr	Phe	Thr	Val	Leu	Pro	Leu	Glu	Ile	Gly	Leu	His	Asn	Ile	Asn	Phe
			900					905					910		
Ser	Leu	Glu	Thr	Trp	Phe	Gly	Lys	Glu	Ile	Leu	Val	Lys	Thr	Leu	Arg
		915					920						925		
Val	Val	Pro	Glu	Gly	Val	Lys	Arg	Glu	Ser	Tyr	Ser	Gly	Val	Thr	Leu
		930				935						940			
Asp	Pro	Arg	Gly	Ile	Tyr	Gly	Thr	Ile	Ser	Arg	Arg	Lys	Glu	Phe	Pro
945					950					955					960
Tyr	Arg	Ile	Pro	Leu	Asp	Leu	Val	Pro	Lys	Thr	Glu	Ile	Lys	Arg	Ile
				965					970					975	
Leu	Ser	Val	Lys	Gly	Leu	Leu	Val	Gly	Glu	Ile	Leu	Ser	Ala	Val	Leu
			980					985					990		
Ser	Gln	Glu	Gly	Ile	Asn	Ile	Leu	Thr	His	Leu	Pro	Lys	Gly	Ser	Ala
		995					1000					1005			
Glu	Ala	Glu	Leu	Met	Ser	Val	Val	Pro	Val	Phe	Tyr	Val	Phe	His	Tyr
		1010					1015					1020			
Leu	Glu	Thr	Gly	Asn	His	Trp	Asn	Ile	Phe	His	Ser	Asp	Pro	Leu	Ile
1025					1030					1035					1040
Glu	Lys	Gln	Lys	Leu	Lys	Lys	Lys	Leu	Lys	Glu	Gly	Met	Leu	Ser	Ile
				1045					1050					1055	
Met	Ser	Tyr	Arg	Asn	Ala	Asp	Tyr	Ser	Tyr	Ser	Val	Trp	Lys	Gly	Gly
			1060					1065					1070		
Ser	Ala	Ser	Thr	Trp	Leu	Thr	Ala	Phe	Ala	Leu	Arg	Val	Leu	Gly	Gln
			1075				1080						1085		
Val	Asn	Lys	Tyr	Val	Glu	Gln	Asn	Gln	Asn	Ser	Ile	Cys	Asn	Ser	Leu
1090						1095						1100			

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Leu Trp Leu Val Glu Asn Tyr Gln Leu Asp Asn Gly Ser Phe Lys Glu	
1105	1110 1115 1120
Asn Ser Gln Tyr Gln Pro Ile Lys Leu Gln Gly Thr Leu Pro Val Glu	
	1125 1130 1135
Ala Arg Glu Asn Ser Leu Tyr Leu Thr Ala Phe Thr Val Ile Gly Ile	
	1140 1145 1150
Arg Lys Ala Phe Asp Ile Cys Pro Leu Val Lys Ile Asp Thr Ala Leu	
	1155 1160 1165
Ile Lys Ala Asp Asn Phe Leu Leu Glu Asn Thr Leu Pro Ala Gln Ser	
	1170 1175 1180
Thr Phe Thr Leu Ala Ile Ser Ala Tyr Ala Leu Ser Leu Gly Asp Lys	
1185	1190 1195 1200
Thr His Pro Gln Phe Arg Ser Ile Val Ser Ala Leu Lys Arg Glu Ala	
	1205 1210 1215
Leu Val Lys Gly Asn Pro Pro Ile Tyr Arg Phe Trp Lys Asp Asn Leu	
	1220 1225 1230
Gln His Lys Asp Ser Ser Val Pro Asn Thr Gly Thr Ala Arg Met Val	
	1235 1240 1245
Glu Thr Thr Ala Tyr Ala Leu Leu Thr Ser Leu Asn Leu Lys Asp Ile	
	1250 1255 1260
Asn Tyr Val Asn Pro Val Ile Lys Trp Leu Ser Glu Glu Gln Arg Tyr	
1265	1270 1275 1280
Gly Gly Gly Phe Tyr Ser Thr Gln Asp Thr Ile Asn Ala Ile Glu Gly	
	1285 1290 1295
Leu Thr Glu Tyr Ser Leu Leu Val Lys Gln Leu Arg Leu Ser Met Asp	
	1300 1305 1310
Ile Asp Val Ser Tyr Lys His Lys Gly Ala Leu His Asn Tyr Lys Met	
	1315 1320 1325
Thr Asp Lys Asn Phe Leu Gly Arg Pro Val Glu Val Leu Leu Asn Asp	
	1330 1335 1340
Asp Leu Ile Val Ser Thr Gly Phe Gly Ser Gly Leu Ala Thr Val His	
1345	1350 1355 1360
Val Thr Thr Val Val His Lys Thr Ser Thr Ser Glu Glu Val Cys Ser	
	1365 1370 1375
Phe Tyr Leu Lys Ile Asp Thr Gln Asp Ile Glu Ala Ser His Tyr Arg	
	1380 1385 1390
Gly Tyr Gly Asn Ser Asp Tyr Lys Arg Ile Val Ala Cys Ala Ser Tyr	
	1395 1400 1405
Lys Pro Ser Arg Glu Glu Ser Ser Ser Gly Ser Ser His Ala Val Met	
	1410 1415 1420
Asp Ile Ser Leu Pro Thr Gly Ile Ser Ala Asn Glu Glu Asp Leu Lys	
1425	1430 1435 1440
Ala Leu Val Glu Gly Val Asp Gln Leu Phe Thr Asp Tyr Gln Ile Lys	
	1445 1450 1455
Asp Gly His Val Ile Leu Gln Leu Asn Ser Ile Pro Ser Ser Asp Phe	
	1460 1465 1470
Leu Cys Val Arg Phe Arg Ile Phe Glu Leu Phe Glu Val Gly Phe Leu	
	1475 1480 1485
Ser Pro Ala Thr Phe Thr Val Tyr Glu Tyr His Arg Pro Asp Lys Gln	
	1490 1495 1500
Cys Thr Met Phe Tyr Ser Thr Ser Asn Ile Lys Ile Gln Lys Val Cys	
1505	1510 1515 1520

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Glu	Gly	Ala	Ala	Cys	Lys	Cys	Val	Glu	Ala	Asp	Cys	Gly	Gln	Met	Gln
				1525					1530					1535	
Glu	Glu	Leu	Asp	Leu	Thr	Ile	Ser	Ala	Glu	Thr	Arg	Lys	Gln	Thr	Ala
			1540					1545					1550		
Cys	Lys	Pro	Glu	Ile	Ala	Tyr	Ala	Tyr	Lys	Val	Ser	Ile	Thr	Ser	Ile
		1555					1560					1565			
Thr	Val	Glu	Asn	Val	Phe	Val	Lys	Tyr	Lys	Ala	Thr	Leu	Leu	Asp	Ile
	1570					1575					1580				
Tyr	Lys	Thr	Gly	Glu	Ala	Val	Ala	Glu	Lys	Asp	Ser	Glu	Ile	Thr	Phe
1585				1590					1595						1600
Ile	Lys	Lys	Val	Thr	Cys	Thr	Asn	Ala	Glu	Leu	Val	Lys	Gly	Arg	Gln
			1605						1610					1615	
Tyr	Leu	Ile	Met	Gly	Lys	Glu	Ala	Leu	Gln	Ile	Lys	Tyr	Asn	Phe	Ser
			1620					1625					1630		
Phe	Arg	Tyr	Ile	Tyr	Pro	Leu	Asp	Ser	Leu	Thr	Trp	Ile	Glu	Tyr	Trp
		1635				1640						1645			
Pro	Arg	Asp	Thr	Thr	Cys	Ser	Ser	Cys	Gln	Ala	Phe	Leu	Ala	Asn	Leu
	1650					1655					1660				
Asp	Glu	Phe	Ala	Glu	Asp	Ile	Phe	Leu	Asn	Gly	Cys				
1665				1670					1675						
<210> SEQ ID NO 62															
<211> LENGTH: 673															
<212> TYPE: PRT															
<213> ORGANISM: Homo sapiens															
<400> SEQUENCE: 62															
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1				5					10					15	
Trp	Gly	Gln	Glu	Gln	Thr	Tyr	Val	Ile	Ser	Ala	Pro	Lys	Ile	Phe	Arg
		20					25					30			
Val	Gly	Ala	Ser	Glu	Asn	Ile	Val	Ile	Gln	Val	Tyr	Gly	Tyr	Thr	Glu
		35				40					45				
Ala	Phe	Asp	Ala	Thr	Ile	Ser	Ile	Lys	Ser	Tyr	Pro	Asp	Lys	Lys	Phe
	50					55				60					
Ser	Tyr	Ser	Ser	Gly	His	Val	His	Leu	Ser	Ser	Glu	Asn	Lys	Phe	Gln
65				70					75					80	
Asn	Ser	Ala	Ile	Leu	Thr	Ile	Gln	Pro	Lys	Gln	Leu	Pro	Gly	Gly	Gln
			85					90					95		
Asn	Pro	Val	Ser	Tyr	Val	Tyr	Leu	Glu	Val	Val	Ser	Lys	His	Phe	Ser
		100					105					110			
Lys	Ser	Lys	Arg	Met	Pro	Ile	Thr	Tyr	Asp	Asn	Gly	Phe	Leu	Phe	Ile
		115				120					125				
His	Thr	Asp	Lys	Pro	Val	Tyr	Thr	Pro	Asp	Gln	Ser	Val	Lys	Val	Arg
	130					135				140					
Val	Tyr	Ser	Leu	Asn	Asp	Asp	Leu	Lys	Pro	Ala	Lys	Arg	Glu	Thr	Val
145				150					155					160	
Leu	Thr	Phe	Ile	Asp	Pro	Glu	Gly	Ser	Glu	Val	Asp	Met	Val	Glu	Glu
			165				170						175		
Ile	Asp	His	Ile	Gly	Ile	Ile	Ser	Phe	Pro	Asp	Phe	Lys	Ile	Pro	Ser
		180					185					190			
Asn	Pro	Arg	Tyr	Gly	Met	Trp	Thr	Ile	Lys	Ala	Lys	Tyr	Lys	Glu	Asp
		195				200						205			
Phe	Ser	Thr	Thr	Gly	Thr	Ala	Tyr	Phe	Glu	Val	Lys	Glu	Tyr	Val	Leu
	210					215					220				

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Pro	His	Phe	Ser	Val	Ser	Ile	Glu	Pro	Glu	Tyr	Asn	Phe	Ile	Gly	Tyr	225	230	235	240
Lys	Asn	Phe	Lys	Asn	Phe	Glu	Ile	Thr	Ile	Lys	Ala	Arg	Tyr	Phe	Tyr	245	250	255	
Asn	Lys	Val	Val	Thr	Glu	Ala	Asp	Val	Tyr	Ile	Thr	Phe	Gly	Ile	Arg	260	265	270	
Glu	Asp	Leu	Lys	Asp	Asp	Gln	Lys	Glu	Met	Met	Gln	Thr	Ala	Met	Gln	275	280	285	
Asn	Thr	Met	Leu	Ile	Asn	Gly	Ile	Ala	Gln	Val	Thr	Phe	Asp	Ser	Glu	290	295	300	
Thr	Ala	Val	Lys	Glu	Leu	Ser	Tyr	Tyr	Ser	Leu	Glu	Asp	Leu	Asn	Asn	305	310	315	320
Lys	Tyr	Leu	Tyr	Ile	Ala	Val	Thr	Val	Ile	Glu	Ser	Thr	Gly	Gly	Phe	325	330	335	
Ser	Glu	Glu	Ala	Glu	Ile	Pro	Gly	Ile	Lys	Tyr	Val	Leu	Ser	Pro	Tyr	340	345	350	
Lys	Leu	Asn	Leu	Val	Ala	Thr	Pro	Leu	Phe	Leu	Lys	Pro	Gly	Ile	Pro	355	360	365	
Tyr	Pro	Ile	Lys	Val	Gln	Val	Lys	Asp	Ser	Leu	Asp	Gln	Leu	Val	Gly	370	375	380	
Gly	Val	Pro	Val	Thr	Leu	Asn	Ala	Gln	Thr	Ile	Asp	Val	Asn	Gln	Glu	385	390	395	400
Thr	Ser	Asp	Leu	Asp	Pro	Ser	Lys	Ser	Val	Thr	Arg	Val	Asp	Asp	Gly	405	410	415	
Val	Ala	Ser	Phe	Val	Leu	Asn	Leu	Pro	Ser	Gly	Val	Thr	Val	Leu	Glu	420	425	430	
Phe	Asn	Val	Lys	Thr	Asp	Ala	Pro	Asp	Leu	Pro	Glu	Glu	Asn	Gln	Ala	435	440	445	
Arg	Glu	Gly	Tyr	Arg	Ala	Ile	Ala	Tyr	Ser	Ser	Leu	Ser	Gln	Ser	Tyr	450	455	460	
Leu	Tyr	Ile	Asp	Trp	Thr	Asp	Asn	His	Lys	Ala	Leu	Leu	Val	Gly	Glu	465	470	475	480
His	Leu	Asn	Ile	Ile	Val	Thr	Pro	Lys	Ser	Pro	Tyr	Ile	Asp	Lys	Ile	485	490	495	
Thr	His	Tyr	Asn	Tyr	Leu	Ile	Leu	Ser	Lys	Gly	Lys	Ile	Ile	His	Phe	500	505	510	
Gly	Thr	Arg	Glu	Lys	Phe	Ser	Asp	Ala	Ser	Tyr	Gln	Ser	Ile	Asn	Ile	515	520	525	
Pro	Val	Thr	Gln	Asn	Met	Val	Pro	Ser	Ser	Arg	Leu	Leu	Val	Tyr	Tyr	530	535	540	
Ile	Val	Thr	Gly	Glu	Gln	Thr	Ala	Glu	Leu	Val	Ser	Asp	Ser	Val	Trp	545	550	555	560
Leu	Asn	Ile	Glu	Glu	Lys	Cys	Gly	Asn	Gln	Leu	Gln	Val	His	Leu	Ser	565	570	575	
Pro	Asp	Ala	Asp	Ala	Tyr	Ser	Pro	Gly	Gln	Thr	Val	Ser	Leu	Asn	Met	580	585	590	
Ala	Thr	Gly	Met	Asp	Ser	Trp	Val	Ala	Leu	Ala	Ala	Val	Asp	Ser	Ala	595	600	605	
Val	Tyr	Gly	Val	Gln	Arg	Gly	Ala	Lys	Lys	Pro	Leu	Glu	Arg	Val	Phe	610	615	620	
Gln	Phe	Leu	Glu	Lys	Ser	Asp	Leu	Gly	Cys	Gly	Ala	Gly	Gly	Gly	Leu	625	630	635	640

gaggtgcagc	tggtggagtc	tggcggcgga	ctggtgcagc	ctggcggaa	cttgcggctg	60
tcttgcgcgc	cctccggatt	ctccttcagt	ggcaggtact	ggatacaatg	ggtgcggcag	120
gcccttgcca	agggcctcga	gtgggtggcc	agtggttggc	cgggggcgac	tggtgacact	180
aactacgcga	actgggcgaa	aggccggttc	accatctccc	gggacgactc	caagaacacc	240
ctgtacctgc	agatgaactc	cctgcggggc	gaggacaccg	cctgtgacta	ctgcgccaga	300

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gaacctgttg cctggggtgg cggcttggac ttgtggggcc agggcacact agtgaccgtg	360
tcctcc	366

<210> SEQ ID NO 66
<211> LENGTH: 366
<212> TYPE: DNA
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 66

gaggtgcagc tgggtggagtc tggcggcgga ctggtgcagc ctggcggaag cttgcggctg	60
tcctgcgccg cctccgatt ctccctcagt ggcaggtact ggatacaatg ggtgcggcag	120
gcccctggca agggcctcga gtgggtggcc agttctagtt tgccgggggac tggtgacact	180
aactacgcga actgggcgaa aggccggttc accatctccc gggacgactc caagaacacc	240
ctgtacctgc agatgaactc cctgcggggc gaggacaccg ccgtgtacta ctgcgccaga	300
gaacctgttg cctggggtgg cggcttggac ttgtggggcc agggcacact agtgaccgtg	360
tcctcc	366

<210> SEQ ID NO 67
<211> LENGTH: 366
<212> TYPE: DNA
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 67

gaggtgcagc tgggtggagtc tggcggcgga ctggtgcagc ctggcggaag cttgcggctg	60
tcctgcgccg cctccgatt ctccctcagt ggcaggtact ggatacaatg ggtgcggcag	120
gcccctggca agggcctcga gtgggtggcc tcggtgtggc cgggggtttac tggtgacact	180
aactacgcga actgggcgaa aggccggttc accatctccc gggacgactc caagaacacc	240
ctgtacctgc agatgaactc cctgcggggc gaggacaccg ccgtgtacta ctgcgccaga	300
gaacctgttg cctggggtgg cggcttggac ttgtggggcc agggcacact agtgaccgtg	360
tcctcc	366

<210> SEQ ID NO 68
<211> LENGTH: 366
<212> TYPE: DNA
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 68

gaggtgcagc tgggtggagtc tggcggcgga ctggtgcagc ctggcggaag cttgcggctg	60
tcctgcgccg cctccgatt ctccctcagt ggcaggtact ggatacaatg ggtgcggcag	120
gcccctggca agggcctcga gtgggtggcc agtggttggc cggggggcgac tggtgacact	180
aactacgcga actgggcgaa aggccggttc accatctccc gggacgactc caagaacacc	240
ctgtacctgc agatgaactc cctgcggggc gaggacaccg ccgtgtacta ctgcgccaga	300
gaacctgttg cctggggtgg cggcttggac ttgtggggcc agggcacact agtgaccgtg	360
tcctcc	366

<210> SEQ ID NO 69
<211> LENGTH: 366
<212> TYPE: DNA
<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 69

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gaggtgcagc tgggtggagtc tggcggcgga ctggtgcagc ctggcggaag cttgcggctg	60
tcctgcgcgc cctccggatt ctccctcagt ggcaggtact ggatacaatg ggtgcggcag	120
gcccctggca agggcctcga gtgggtggcc tcggtgtggc cggggtttac tggtgacact	180
aactacgcga actgggcgaa aggcgggttc accatctccc gggacgactc caagaacacc	240
ctgtacctgc agatgaactc cctgcggggc gaggacaccg ccgtgtacta ctgcgccaga	300
gaacctgttg cctgggggtgg cggcttggac ttgtggggcc agggcacact agtgaccgtg	360
tcctcc	366

<210> SEQ ID NO 70
 <211> LENGTH: 330
 <212> TYPE: DNA
 <213> ORGANISM: Homo sapiens

<400> SEQUENCE: 70

gacatccaga tgaccagtc cccctcctcg ctgagcgct ccgtgggcga ccgggtgacc	60
atcacctgcc aggccagtca gagcattaac aaccaactat cctggtatca gcagaagcct	120
ggcaaggcgc ctaagctgct gatctactat gcatccactc tggcatctgg cgtgccttcc	180
cggttctccg gatccggctc cggcaccgac ttcacctga ccatctctc cctgcaacct	240
gaggacttcg ccacctacta ctgccaaggc agttattata gtggtggttg ggactatggt	300
ttcggccagg gtaccaagg ggagatcaag	330

<210> SEQ ID NO 71
 <211> LENGTH: 38
 <212> TYPE: DNA
 <213> ORGANISM: Artificial Sequence
 <220> FEATURE:
 <223> OTHER INFORMATION: Vk 5' Sense Primers - RSCVK1

<400> SEQUENCE: 71

gggcccaggc ggccgagctc gtgmtgacct agactcca	38
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<210> SEQ ID NO 72
 <211> LENGTH: 38
 <212> TYPE: DNA
 <213> ORGANISM: Artificial Sequence
 <220> FEATURE:
 <223> OTHER INFORMATION: Vk 5' Sense Primers - RSCVK2

<400> SEQUENCE: 72

gggcccaggc ggccgagctc gatmtgacct agactcca	38
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<210> SEQ ID NO 73
 <211> LENGTH: 38
 <212> TYPE: DNA
 <213> ORGANISM: Artificial Sequence
 <220> FEATURE:
 <223> OTHER INFORMATION: Vk 5' Sense Primers - RSCVK3

<400> SEQUENCE: 73

gggcccaggc ggccgagctc gtgatgacct agactgaa	38
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<210> SEQ ID NO 74
 <211> LENGTH: 75
 <212> TYPE: DNA
 <213> ORGANISM: Artificial Sequence
 <220> FEATURE:
 <223> OTHER INFORMATION: Vk 3' Reverse Primers, LongLinker - RKB9J1o-BL

<400> SEQUENCE: 74

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ggaagatcta gaggaaccac ccccaccacc gcccgagcca ccgccaccag aggataggat 60
ctccagctcg gtccc 75

<210> SEQ ID NO 75
<211> LENGTH: 75
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Vk 3' Reverse Primers, LongLinker - RKB9Jo-BL

<400> SEQUENCE: 75

ggaagatcta gaggaaccac ccccaccacc gcccgagcca ccgccaccag aggataggat 60
ctccagctcg gtccc 75

<210> SEQ ID NO 76
<211> LENGTH: 75
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Vk 3' Reverse Primers, LongLinker - RKB42Jo-BL

<400> SEQUENCE: 76

ggaagatcta gaggaaccac ccccaccacc gcccgagcca ccgccaccag aggatttgac 60
saccacctcg gtccc 75

<210> SEQ ID NO 77
<211> LENGTH: 40
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: V lamda 5'Sense Primer - RSC lamda 1

<400> SEQUENCE: 77

gggcccaggc ggccgagctc gtgctgactc agtcgccctc 40

<210> SEQ ID NO 78
<211> LENGTH: 78
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: V lamda 3'Reverse Primer, LongLinker - RJ lamda
o-BL

<400> SEQUENCE: 78

ggaagatcta gaggaaccac ccccaccacc gcccgagcca ccgccaccag aggagcctgt 60
gacggtcagc tgggtccc 78

<210> SEQ ID NO 79
<211> LENGTH: 42
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: VH5'Sense Primers - RSCVH1

<400> SEQUENCE: 79

ggtgggtcct ctagatcttc ccagtcggtg gaggagtccr gg 42

<210> SEQ ID NO 80
<211> LENGTH: 42
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: VH5'Sense Primers - RSCVH2

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<400> SEQUENCE: 80

ggtgggttcct ctatgcttcc ccagtcggtg aaggagtcgc ag 42

<210> SEQ ID NO 81

<211> LENGTH: 42

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: VH5'Sense Primers - RSCVH3

<400> SEQUENCE: 81

ggtgggttcct ctatgcttcc ccagtcgytg gaggagtcgc gg 42

<210> SEQ ID NO 82

<211> LENGTH: 44

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: VH5'Sense Primers - RSCVH4

<400> SEQUENCE: 82

ggtgggttcct ctatgcttcc ccagsagcag ctgrtggagt ccgg 44

<210> SEQ ID NO 83

<211> LENGTH: 46

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: VH3'Reverse Primers -RSCG-B

<400> SEQUENCE: 83

cctggccggc ctggccacta gtgactgayg gagccttagg ttgccc 46

<210> SEQ ID NO 84

<211> LENGTH: 41

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Overlap Extension Primers - RSC-F (sense)

<400> SEQUENCE: 84

gaggaggagg aggaggaggc gggggccagg cggccgagct c 41

<210> SEQ ID NO 85

<211> LENGTH: 41

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Overlap Extension Primers - RSC-B (reverse)

<400> SEQUENCE: 85

gaggaggagg aggaggaggc tggccggcct ggccactagt g 41

<210> SEQ ID NO 86

<211> LENGTH: 38

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: V lamda Primers - CSCVK (sense)

<400> SEQUENCE: 86

gtggcccagg cggccctgac tcagccgtcc tcggtgtc 38

<210> SEQ ID NO 87

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<211> LENGTH: 34
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: V lamda Primers - CKJo-B (reverse)

<400> SEQUENCE: 87

ggaagatcta gaggactgac ctaggacggt cagg 34

<210> SEQ ID NO 88
<211> LENGTH: 72
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: VHPrimers - CSCVHo-FL (sense)

<400> SEQUENCE: 88

ggtcagtect ctagatcttc cggcgggtggt ggcagctccg gtggtggcgg ttccgccgtg 60
acgttggacg ag 72

<210> SEQ ID NO 89
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<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: VHPrimers - CSCG-B (reverse)

<400> SEQUENCE: 89

ctggccggcc tggccactag tggaggagac gatgacttcg gtcc 44

<210> SEQ ID NO 90
<211> LENGTH: 42
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Overlap Extension Primers - CSC-F (sense)

<400> SEQUENCE: 90

gaggaggagg aggaggaggt ggcccaggcg gccctgactc ag 42

<210> SEQ ID NO 91
<211> LENGTH: 47
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Overlap Extension Primers - CSC-B (reverse)

<400> SEQUENCE: 91

gaggaggagg aggaggagga gctggccggc ctggccacta gtggagg 47

<210> SEQ ID NO 92
<211> LENGTH: 36
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Forward primers - MG1-F

<400> SEQUENCE: 92

ggcccaggcg gccatgggcc ttttgggaat actttg 36

<210> SEQ ID NO 93
<211> LENGTH: 36
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Forward primers - MG2-F

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<400> SEQUENCE: 93

ggcccaggcg gccaatggat ttctcttcat tcatac 36

<210> SEQ ID NO 94

<211> LENGTH: 34

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Forward primers - MG3-F

<400> SEQUENCE: 94

ggcccaggcg gcccacatt tttctgtctc aatc 34

<210> SEQ ID NO 95

<211> LENGTH: 34

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Forward primers - MG4-F

<400> SEQUENCE: 95

ggcccaggcg gcctctccct acaaactgaa ttg 34

<210> SEQ ID NO 96

<211> LENGTH: 34

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Forward primers- MG5-F

<400> SEQUENCE: 96

ggcccaggcg gccactgata accataaggc ttg 34

<210> SEQ ID NO 97

<211> LENGTH: 30

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Forward primers- Linker-F

<400> SEQUENCE: 97

ggcccaggcg gcctctggg tggcattagc 30

<210> SEQ ID NO 98

<211> LENGTH: 34

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Reverse primers - MG1-R

<400> SEQUENCE: 98

ggccggcctg gccgtcatag gttattggca ttct 34

<210> SEQ ID NO 99

<211> LENGTH: 34

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Reverse primers - MG2-R

<400> SEQUENCE: 99

ggccggcctg gcccaagaca tattctttaa cttc 34

<210> SEQ ID NO 100

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<211> LENGTH: 33
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Reverse primers - MG3-R

<400> SEQUENCE: 100

ggccggcctg gccgaggaca tatttgatgc cag 33

<210> SEQ ID NO 101
<211> LENGTH: 37
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Reverse primers - MG4-R

<400> SEQUENCE: 101

ggccggcctg gcccacatca atataaaggt aactttg 37

<210> SEQ ID NO 102
<211> LENGTH: 35
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Reverse primers - MG5-R

<400> SEQUENCE: 102

ggccggcctg gccatccatt ccagttgccca tatta 35

<210> SEQ ID NO 103
<211> LENGTH: 34
<212> TYPE: DNA
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<220> FEATURE:
<223> OTHER INFORMATION: Reverse primers - Linker-R

<400> SEQUENCE: 103

ggccggcctg gccgagaatt tctttacaag gtgc 34

<210> SEQ ID NO 104
<211> LENGTH: 34
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Forward primers - hMG4-F

<400> SEQUENCE: 104

ggcccaggcg gcctctccct acaaactgaa ttg 34

<210> SEQ ID NO 105
<211> LENGTH: 32
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Forward primers- d332-348_F

<400> SEQUENCE: 105

ggcccaggcg gccattccat atcccatcaa gg 32

<210> SEQ ID NO 106
<211> LENGTH: 34
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Forward primers- d332-378-F

<400> SEQUENCE: 106

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ggcccaggcg gccgtaaacc aagagacatc tgac	34
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ggcccaggcg gccgatggag tagcttcctt tg	32
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ggcccaggcg gcccagaag aaaatcaggc c	31
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ggccggcctg gcccgaatca atataaaggt aactttg	37
<210> SEQ ID NO 110 <211> LENGTH: 86 <212> TYPE: DNA <213> ORGANISM: Artificial Sequence <220> FEATURE: <223> OTHER INFORMATION: Construction of hMG4-m332-348 - m332-348F	
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ggcccaggcg gcctctccct acacactgaa tttggtcgct actcctcttt tcgtgaagcc	60
cgggattcca tateccatca aggtgc	86
<210> SEQ ID NO 111 <211> LENGTH: 34 <212> TYPE: DNA <213> ORGANISM: Artificial Sequence <220> FEATURE: <223> OTHER INFORMATION: Construction of hMG4-m332-348 - hMG4_R	
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ggcccaggcg gcctctccct acaaactgaa tttg	34
<210> SEQ ID NO 112 <211> LENGTH: 22 <212> TYPE: DNA <213> ORGANISM: Artificial Sequence <220> FEATURE: <223> OTHER INFORMATION: Forward primer - mMG4_F (Mouse MG4 N-terminal)	
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tctccctaca cactgaattt gg	22
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<211> LENGTH: 28 <212> TYPE: DNA <213> ORGANISM: Artificial Sequence <220> FEATURE: <223> OTHER INFORMATION: Reverse primer - m332-359_R (Mouse MG4 N-terminal)	
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gtcaagcgaa tctttaacct gtgccttg	28
<210> SEQ ID NO 114 <211> LENGTH: 27 <212> TYPE: DNA <213> ORGANISM: Artificial Sequence <220> FEATURE: <223> OTHER INFORMATION: Reverse primer - m332-368_R (Mouse MG4 N-terminal)	
<400> SEQUENCE: 114	
tgttactggg acccctccta cgcctg	27
<210> SEQ ID NO 115 <211> LENGTH: 28 <212> TYPE: DNA <213> ORGANISM: Artificial Sequence <220> FEATURE: <223> OTHER INFORMATION: Reverse primer - m332-378_R (Mouse MG4 N-terminal)	
<400> SEQUENCE: 115	
ttggtttaca tcgactgttt gtgccatc	28
<210> SEQ ID NO 116 <211> LENGTH: 30 <212> TYPE: DNA <213> ORGANISM: Artificial Sequence <220> FEATURE: <223> OTHER INFORMATION: Reverse primer - m332-385_R (Mouse MG4 N-terminal)	
<400> SEQUENCE: 116	
tggatccaag tcagatgtct cttgattcac	30
<210> SEQ ID NO 117 <211> LENGTH: 28 <212> TYPE: DNA <213> ORGANISM: Artificial Sequence <220> FEATURE: <223> OTHER INFORMATION: Reverse primer - m332-392_R (Mouse MG4 N-terminal)	
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aacacgtgtg atgctcctct ttgtttcc	28
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ggaagctact ccatcagtgt catgagtg	28
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<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Reverse primer - m332-409_R (Mouse MG4 N-terminal)

<400> SEQUENCE: 119

cacgcgcaca ttgatggga gggtcagc 28

<210> SEQ ID NO 120
<211> LENGTH: 28
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Forward primer - m332-359_F (Human MG4 C-terminal)

<400> SEQUENCE: 120

gttaaagatt cgcttgacca gttggtag 28

<210> SEQ ID NO 121
<211> LENGTH: 28
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Forward primer - m332-368_F (Human MG4 C-terminal)

<400> SEQUENCE: 121

ggaggggtcc cagtaacact gaatgcac 28

<210> SEQ ID NO 122
<211> LENGTH: 30
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Forward primer -m332-378_F (Human MG4 C-terminal)

<400> SEQUENCE: 122

acagtcgatg taaaccaaga gacatctgac 30

<210> SEQ ID NO 123
<211> LENGTH: 29
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Forward primer -m332-385_F (Human MG4 C-terminal)

<400> SEQUENCE: 123

acatctgact tggatccaag caaaagtgt 29

<210> SEQ ID NO 124
<211> LENGTH: 30
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Forward primer -m332-392_F (Human MG4 C-terminal)

<400> SEQUENCE: 124

aggagcatca cacgtgttga tgatggagta 30

<210> SEQ ID NO 125
<211> LENGTH: 31
<212> TYPE: DNA

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<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Forward primer -m332-398_F (Human MG4 C-terminal)

<400> SEQUENCE: 125

actgatggag tagcttcctt tgtgcttaat c 31

<210> SEQ ID NO 126
<211> LENGTH: 28
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Forward primer -m332-409_F (Human MG4 C-terminal)

<400> SEQUENCE: 126

ccatcaaattg tgacgggtgct ggagttta 28

<210> SEQ ID NO 127
<211> LENGTH: 34
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Reverse primer - hMG4_R (Human MG4 C-terminal)

<400> SEQUENCE: 127

ggcccaggcg gcctctccct acaaactgaa ttg 34

<210> SEQ ID NO 128
<211> LENGTH: 82
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Construction of mMG4-h332-348 - h332-348_F

<400> SEQUENCE: 128

ggcccaggcg gcctctccct acaaactgaa ttgggttget actcctcttt tctgaagcc 60

tgggattcca ttttccatca ag 82

<210> SEQ ID NO 129
<211> LENGTH: 20
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Construction of mMG4-h332-348 - mMG4_R

<400> SEQUENCE: 129

ccaagcgatg taaatgtaac 20

<210> SEQ ID NO 130
<211> LENGTH: 34
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
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<223> OTHER INFORMATION: Forward primer - hMG4-F (Human MG4 N-terminal)

<400> SEQUENCE: 130

ggcccaggcg gcctctccct acaaactgaa ttg 34

<210> SEQ ID NO 131
<211> LENGTH: 29
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Reverse primer - h332-359_R (Human MG4 N-

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terminal)

<400> SEQUENCE: 131

ctcgagtgaa tctttaacct gcaccttga 29

<210> SEQ ID NO 132
<211> LENGTH: 27
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Reverse primer - h332-368_R (Human MG4 N-terminal)

<400> SEQUENCE: 132

agttactggg actcctccta ccaactg 27

<210> SEQ ID NO 133
<211> LENGTH: 30
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Reverse primer - h332-378_R (Human MG4 N-terminal)

<400> SEQUENCE: 133

ttgattcaca tcaattgttt gtgcattcag 30

<210> SEQ ID NO 134
<211> LENGTH: 30
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Reverse primer - h332-385_R (Human MG4 N-terminal)

<400> SEQUENCE: 134

tgtttccaag tcagatgtct cttggtttac 30

<210> SEQ ID NO 135
<211> LENGTH: 29
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Reverse primer - h332-392_R (Human MG4 N-terminal)

<400> SEQUENCE: 135

gtcatgagtt acacttttgc ttggatcca 29

<210> SEQ ID NO 136
<211> LENGTH: 30
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Reverse primer - h332-398_R (Human MG4 N-terminal)

<400> SEQUENCE: 136

cacagctact ccatcatcaa cacgtgttac 30

<210> SEQ ID NO 137
<211> LENGTH: 30
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
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<223> OTHER INFORMATION: Reverse primer - h332-409_R (Human MG4 N-terminal)

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<400> SEQUENCE: 137
caccgtcact ccagatggga gattaagcac 30

<210> SEQ ID NO 138
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<212> TYPE: DNA
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<220> FEATURE:
<223> OTHER INFORMATION: Forward primer - h332-359_F (Mouse MG4 C-terminal)

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gttaaagatt cactcgagca ggcggg 26

<210> SEQ ID NO 139
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<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Forward primer - h332-368_F (Mouse MG4 C-terminal)

<400> SEQUENCE: 139
ggaggagtcc cagtaactct gatggcac 28

<210> SEQ ID NO 140
<211> LENGTH: 30
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Forward primer - h332-378_F (Mouse MG4 C-terminal)

<400> SEQUENCE: 140
acaattgatg tgaatcaaga gacatctgac 30

<210> SEQ ID NO 141
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<212> TYPE: DNA
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<223> OTHER INFORMATION: Forward primer - h332-385_F (Mouse MG4 C-terminal)

<400> SEQUENCE: 141
acatctgact tggaaacaaa gaggagcatc 30

<210> SEQ ID NO 142
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<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
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<223> OTHER INFORMATION: Forward primer - h332-392_F (Mouse MG4 C-terminal)

<400> SEQUENCE: 142
caaaagtgtg actcatgaca ctgatggag 29

<210> SEQ ID NO 143
<211> LENGTH: 30
<212> TYPE: DNA
<213> ORGANISM: Artificial Sequence
<220> FEATURE:
<223> OTHER INFORMATION: Forward primer - h332-398_F (Mouse MG4 C-terminal)

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<400> SEQUENCE: 143

gatgatggag tagctgtgtt tgtgctgaac

30

<210> SEQ ID NO 144

<211> LENGTH: 28

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Forward primer - h332-409_F (Mouse MG4 C-terminal)

<400> SEQUENCE: 144

ccatctggag tgacggtgct aaagtttg

28

<210> SEQ ID NO 145

<211> LENGTH: 20

<212> TYPE: DNA

<213> ORGANISM: Artificial Sequence

<220> FEATURE:

<223> OTHER INFORMATION: Reverse primer - mMG4_R (Mouse MG4 C-terminal)

<400> SEQUENCE: 145

ccaagcgatg taaatgtaac

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What is claimed is:

1. A monoclonal antibody binding to human complement component 5 (C5) protein or antigen-binding fragment thereof, comprising a heavy chain CDR1 of SEQ ID NO: 1, a heavy chain CDR2 of SEQ ID NO: 2, a heavy chain CDR3 of SEQ ID NO: 3, a light chain CDR1 of SEQ ID NO: 4, a light chain CDR2 of SEQ ID NO: 5, and a light chain CDR3 of SEQ ID NO: 6.

2. A monoclonal antibody binding to human C5 protein or antigen-binding fragment thereof, comprising a heavy chain CDR1 of SEQ ID NO: 11, a heavy chain CDR2 of SEQ ID NO: 12, a heavy chain CDR3 of SEQ ID NO: 3, a light chain CDR1 of SEQ ID NO: 4, a light chain CDR2 of SEQ ID NO: 5, and a light chain CDR3 of SEQ ID NO: 6.

3. A monoclonal antibody binding to human C5 protein or antigen-binding fragment thereof, comprising a heavy chain CDR1 of SEQ ID NO: 21, a heavy chain CDR2 of SEQ ID NO: 22, a heavy chain CDR3 of SEQ ID NO: 3, a light chain CDR1 of SEQ ID NO: 4, a light chain CDR2 of SEQ ID NO: 5, and a light chain CDR3 of SEQ ID NO: 6.

4. A monoclonal antibody binding to human C5 protein or antigen-binding fragment thereof, comprising a heavy chain CDR1 of SEQ ID NO: 31, a heavy chain CDR2 of SEQ ID NO: 32, a heavy chain CDR3 of SEQ ID NO: 3, a light chain CDR1 of SEQ ID NO: 4, a light chain CDR2 of SEQ ID NO: 5, and a light chain CDR3 of SEQ ID NO: 6.

5. A monoclonal antibody binding to human C5 protein or antigen-binding fragment thereof, comprising a heavy chain CDR1 of SEQ ID NO: 41, a heavy chain CDR2 of SEQ ID NO: 42, a heavy chain CDR3 of SEQ ID NO: 3, a light chain CDR1 of SEQ ID NO: 4, a light chain CDR2 of SEQ ID NO: 5, and a light chain CDR3 of SEQ ID NO: 6.

6. A monoclonal antibody binding to human C5 protein or antigen-binding fragment thereof, comprising a heavy chain CDR1 of SEQ ID NO: 51, a heavy chain CDR2 of SEQ ID NO: 52, a heavy chain CDR3 of SEQ ID NO: 3, a light chain CDR1 of SEQ ID NO: 4, a light chain CDR2 of SEQ ID NO: 5, and a light chain CDR3 of SEQ ID NO: 6.

7. A monoclonal antibody binding to human C5 protein or antigen-binding fragment thereof, comprising a heavy chain variable region selected from the group consisting of SEQ ID NO: 7, 17, 27, 37, 47 and 57; and

a light chain variable region of SEQ ID NO: 8.

8. A monoclonal antibody binding to human C5 protein or antigen-binding fragment thereof, comprising a heavy chain selected from the group consisting of SEQ ID NO: 9, 19, 29, 39, 49 and 59; and

a light chain of SEQ ID NO: 10.

9. A pharmaceutical composition, comprising:

the antibody, the monoclonal antibody or antigen-binding fragment thereof according to any one of claims 1-6, 7, and 8.

10. A method for treating complement-related diseases, comprising:

administering a therapeutically effective amount of the antibody or antigen-binding fragment thereof of any one of claims 1-6, 7, and 8 to a subject in need thereof.

11. The method of claim 10, wherein the subject is a human.

12. The method of claim 11, wherein the complement-related diseases are selected from the group consisting of rheumatoid arthritis (RA), osteoarthritis, acute respiratory distress syndrome (ARDS), remote tissue injury after ischemia and reperfusion, complement activation during cardiopulmonary bypass surgery, dermatomyositis, pemphigus, lupus nephritis, glomerulonephritis, renal vasculitis, cardiopulmonary by-pass, heart failure-induced coronary endothelial dysfunction, type II membrane-proliferative glomerulonephritis, acute renal failure, antiphospholipid syndrome, macular degeneration, endophthalmitis, new blood vessel disease, allograft transplantation, hyperacute rejection, hemodialysis, chronic obstructive pulmonary disorder (COPD) respiratory distress syndrome, asthma, paroxysmal nocturnal hemoglobinuria (PNH) and aspiration pneumonia.

13. A kit for detecting a complement cleavage product in a subject with complement-related diseases, the kit comprising:

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the antibody or antigen-binding fragment thereof accord-
ing to any one of claims **1-6**, **7**, and **8**; and
a container.

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